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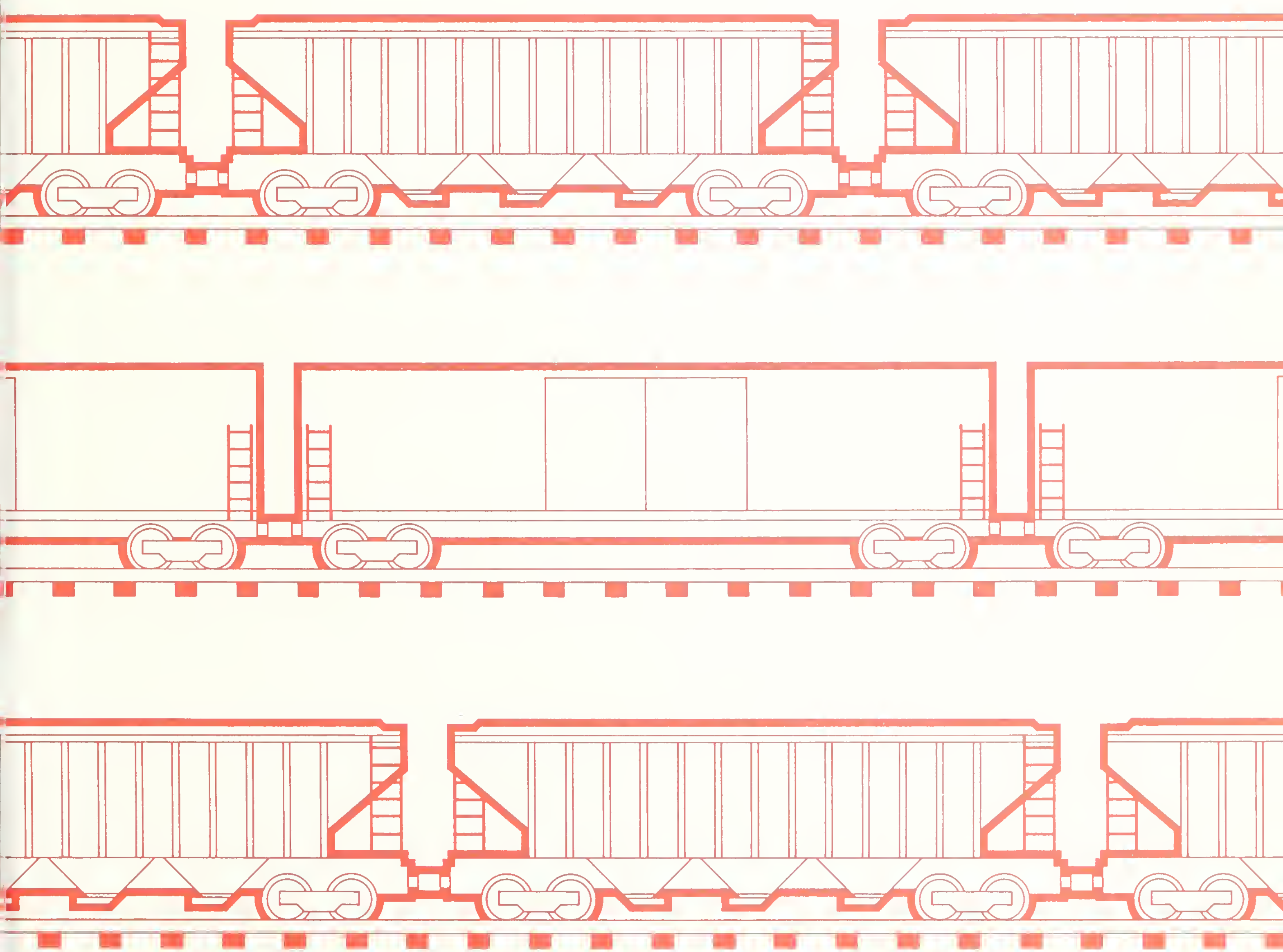
Canada's Grain Handling and Transportation System

Mary Anne Normile



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CANADA'S GRAIN HANDLING AND TRANSPORTATION SYSTEM. Mary Anne Normile. International Economics Division, Economic Research Service, U.S. Department of Agriculture. FAER-192.

Abstract

Transportation problems have caused Canada to lose export sales, according to this status report of Canada's grain handling and transportation system. The study examines the causes of this decline and evaluates the system's capacity to handle larger volumes of grains and oilseeds. Recent changes in infrastructure and coordination of grain movement have improved the system's performance. Further improvements in the Canadian grain handling and transportation system's ability to meet world demand could cut U.S. grain export sales. Capacity will probably be adequate to move 30 million tons of export grain in 1985/86. Added investment will be required to ship 36 million tons in 1990/91.

Keywords: Canada, transportation, grain, oilseeds, grain exports.

Notes

Use of company names in this report is for identification only and does not imply endorsement by the U.S. Department of Agriculture. All units of weight cited in this report are metric. A metric ton is equal to 2,204.6 pounds. All dollar figures refer to Canadian dollars unless otherwise stated. The 1982 Canadian dollar was equal to 0.81 U.S. dollars. The split year (1981/82, for example) refers to the Canadian crop year, August 1 to July 31.

Washington, D.C. 20250 November 1983

Contents

Glossary

Elevators

Primary elevators (country elevators)—Receive grain delivered by farmers by truck, store grain, and load it to railcars for movement to port or other destination.

Process elevators—Receive and store grain in connection with a processing or manufacturing operation.

Terminal elevators—Receive grain which is officially weighed and inspected and clean, treat, and store the grain before it is forwarded. Most terminal elevators are located at ports where they load grain to ships. Canada has five inland terminals which provide reserve terminal storage capacity.

Transfer elevators—Transfer grain that has been officially weighed and inspected at another elevator. Grain from rail or lakers is stored to be transferred to ocean vessels or to trains.

Organizations

Canada Grains Council—A nonprofit organization funded by industry and government to carry out research, advisory, information, and market development activities for the grains industry.

Canadian Grain Commission (CGC)—A regulatory, research, and administrative agency that establishes grades and standards of quality for Canadian grain, performs grading and inspection of grains, and regulates grain handling in Canada.

Canadian Transport Commission (CTC)—Regulatory and rate-setting agency for the railways.

Canadian Wheat Board (CWB)—Marketing agency for export grains (wheat, oats, and barley) produced in western Canada. The CWB also markets some western grain for domestic use.

Grain Transportation Authority (GTA)—Formed in 1979, the GTA oversees allocation of railcars between board (CWB) and nonboard grains and distributes nonboard car allocation to grain shippers. GTA coordinates movement of grain railcars with the CWB and the railways.

Hall Commission—Commission appointed in 1975 to investigate the impacts of branch line abandonment in western Canada and to make recommendations to the Transport Minister on retention or abandonment of unprotected branch lines.

McPherson Royal Commission on Transportation—Appointed in 1961 to investigate problems relating to grain transportation in Canada and the railways' claims of losses incurred in moving statutory grain.

Prairie Rail Action Committee (PRAC)—Formed to make a final determination on abandonment or retention of prairie branch lines recommended for further evaluation by the Hall Commission.

Rails

British Columbia Railway (BCR)—Rail company owned by the Province of British Columbia that moves grain and other commodities within the province.

Canadian National Railway (CN)—A Canadian Government-owned railway. CN is a crown corporation, accountable to the Government but run as a business.

Canadian Pacific Railway (CP)—A privately owned, joint-stock corporation. CP and CN are the two largest railways in Canada, operate coast to coast, and move most of Canada's grain and other freight.

Northern Alberta Railway (NAR)—Railway jointly owned by CN and CP which moves a small amount of western Canadian grain.

Other terms

At and East Subsidy—A subsidy paid to railways that enables them to move western grain for export to east coast ports at reduced rates to shippers.

Block shipping system—Method developed for planning and coordinating the movement of grain from the Prairie Provinces which divides grain supply areas into shipping regions called blocks.

Crow's Nest Pass Agreement—An 1897 agreement between the Canadian Government and CP Rail whereby CP agreed to reduce freight rates on prairie grain destined for export and to charge no higher rates in the future in exchange for a subsidy to build a rail line through the Crow's Nest Pass in the mountains of British Columbia.

Delivery quota system—Method by which the CWB controls delivery of grain to elevators. The CWB announces how much and what kind of grain it will accept and allocates delivery opportunities to producers based on their qualifying acreage.

Feed Freight Assistance Program—A subsidy paid by the Government for transporting feed grains from Thunder Bay to eastern consumption areas and from points in the prairies into British Columbia.

Nonboard (nonCWB) grains—Grains which are not marketed by the CWB. These include rapeseed, rye, flaxseed, and corn.

Offboard market—Sale of wheat, oats, or barley to a purchaser other than the CWB. This market includes farm-to-farm sales, farm-to-feedlot or feedmill sales, and most domestic sales of feed grains.

Prairie Provinces—The Provinces of Manitoba, Saskatchewan, and Alberta lie in the northern prairies and comprise Canada's principal grain-producing area.

Solid trains—Trains composed entirely of cars containing the same commodity (such as grain) although not necessarily the same type. Solid trains are not assembled at a single point and are not unloaded at a single destination.

Statutory grain—Grain shipped by rail at rates set by the Crow's Nest Pass Agreement and related statutes.

Unit trains—Large trains carrying one commodity from a single origin to a single destination, which move as a unit without intermediate stops and avoid switching operations at the terminal.

Highlights

Grain transportation problems, exacerbated by outdated statutory freight rates which discourage rail modernization, have caused Canada to lose export sales. U.S. grain exports may have benefited from Canada's past transportation difficulties. World grain trade greatly expanded over the last decade, but Canada's share of the growing market fell, while the U.S. share rose. This decline can be attributed at least in part to the failure of the grain handling and transportation system to keep pace with rising world demand. In 1977/78, for example, the Canadian Wheat Board turned down requests for additional grain sales of at least 2 million metric tons because it could not assure delivery.

Grain transportation problems result from the large land distances involved, rugged topography, and cold climate. The transportation system has also suffered from an obsolete branch line network, inadequate investment in other rail facilities such as grain cars and main line trackage, and difficulties in coordinating grain flows.

The impact of the Crow's Nest Pass rates—a Government statute which froze freight rates on export grain at 1925 levels—has been pervasive. Chronic rail revenue shortfalls in moving grain have discouraged investments in rail service for grain and service has deteriorated. The Government has imposed a moratorium on abandonment of branch lines, which has perpetuated inefficiencies of an overbuilt branch line system. Government provision of capital stock in the form of grain hopper cars, boxcar repair, and branch line rehabilitation has provided some additional capacity, but bottlenecks remain.

More capital investment is required if the system is to move the projected larger volumes of grain. Prince Rupert's large grain terminal, currently under construction, will add to west coast storage and throughput capacity. More grain hopper cars promised by the Government will ease car shortages through 1985/86; however, car numbers will be inadequate in 1990 unless the time required for cars to complete trips—car cycles—is cut. Serious bottlenecks will continue to constrain throughput on the Canadian National and Canadian Pacific rail main lines west of Edmonton and Calgary. Double-tracking—to allow more efficient movement in both directions—will be necessary to increase main line capacity in addition to a grade reduction project at Rogers Pass. But, these investments will be made only if increased revenues are likely, according to the railways. Other potential bottlenecks are the Welland Canal, the laker fleet, and the St. Lawrence transfer elevators. Capacity of these components to move larger volumes of Canadian grain will depend on the amount of U.S. exports through the Great Lakes-St. Lawrence Seaway.

Canada's grain transportation system can probably move 30 million metric tons of export grain in 1985/86 if proposed additions are completed. However, bottlenecks will develop in the west as exports of nonagricultural bulk commodities resume and exceed their prerecession levels. The Canadian system will be hardpressed to increase grain and oilseed exports to 36 million metric tons by 1990 given proposed investment levels.

Canada could expand its market share, possibly at the expense of U.S. grain and oilseed exports, if the transportation constraint is overcome. Improvements in grain handling and transportation facilities that enable Canada to deliver grain without costly delays will enhance its competitiveness in the world market for grains by helping establish Canada's reputation as a reliable supplier.

An expanded grain handling and transportation system should also encourage more production. Delivery quotas will less often suffer because of elevator congestion as system capacity expands. Producers in Canada tend to base production decisions on stock levels and ease of delivery, rather than small changes in price. If producers believe that their grain will be moved, they will produce that grain.

Resolution of the railways' revenue shortfall due to the Crow's Nest Pass rate is a prerequisite to long-term improvement and continued expansion of rail capacity. Any solution which would increase freight rates paid by producers is expected to have a dampening effect on production of grain for export. The impact of higher freight rates is uncertain, however, because many prairie farmers have few alternatives to grain production because of climatic limitations. If strong demand for grain translates into higher grain prices, the increase in freight rates will assume less importance.

If Crow's Nest Pass rate reform leads to diversification of western agriculture, there may be less grain for export, and therefore less competition from Canadian grains and

oilseeds for U.S. exports. A freight rate increase would also change the composition of Canadian grain and oilseed exports. As feed grain is diverted to local use and livestock production grows, export grain would be dominated by relatively higher valued crops, such as wheat and rapeseed, which compete directly with U.S. wheat and soybeans. The Canadian Government's recent efforts toward reforming the Crow's Nest Pass rates and encouraging continued expansion of rail capacity signal a strong commitment to expanding grain and oilseed exports.

Crow's Nest Pass rate reform may also affect U.S.-Canadian agricultural trade. If the freight rate increase produces the desired agricultural diversification in the west, increased livestock production could reduce Canadian imports of U.S. livestock and livestock products or expand Canadian shipments to the United States.

A prairie wheatfield stretches before western Canada primary elevators.

(photo courtesy of the Canadian Embassy)

Canada's Grain Handling and Transportation System

Mary Anne Normile

Introduction

Canada's share of world grain exports declined during the seventies, due partly to grain handling and transportation problems. The transportation system has been the major constraint preventing Canada from exporting larger amounts of grains and oilseeds. Although some of the system's bottlenecks resulted from rapid growth in world grain demand and the time required to invest in infrastructure, many are the direct or indirect result of Canadian Government policies. Current plans for grain handling and transportation, if successful, could enhance Canada's competitiveness in world grain trade and adversely affect U.S. grain and oilseed exports.

This report documents the current state of Canada's grain handling and transportation system by describing the components of the system and how they interact. The report concentrates on evaluating the system's ability to carry greater volumes of grains and oilseeds and their products.

Shortcomings of Canada's grain handling and transportation system were brought to light in the late seventies when world grain and oilseed trade was brisk and Canada's participation in the market became limited by transportation problems rather than by demand. Deterioration in service was brought about by many factors, not the least of which was Government policy which kept freight rates at levels which did not allow the railways to recover costs and discouraged development of alternate modes. The Government encouraged overbuilding the rail system and then impeded its consolidation; it complicated coordination by multiplying the number of agencies involved in grain transportation. Rapid growth of demand and the lead time required to plan and execute additions to infrastructure was also a cause of poor service, as were some bottlenecks resulting from geographical accident, such as the crowded port of Vancouver. Canada's grain marketing agency, the Canadian Wheat Board (CWB), predicted that the export market for Canadian grains and oilseeds would expand further, to an estimated 30 million tons by 1985 and 36 million tons by 1990. Concern that the grain transportation system would not be able to handle this volume prompted the Federal and Provincial Governments and the CWB to undertake projects to improve the system. Recent investment in rolling stock, track, and terminal elevators has begun to reverse the decline in handling and transport. Failure of these measures to expand adequately the system's capacity will threaten future grain export growth and will jeopardize an important source of export earnings for Canada.

Note: The author, Mary Anne Normile, is an economist in the International Economics Division, ERS.

Background

Difficulties in moving grain to port have resulted from Canada's unique geography, the distances between grain-producing areas and ports, the rapid growth in export demand for grains and oilseeds, and Government policies.

Grain Production Areas

Most grain grown for export is produced in the Prairie Provinces of western Canada (Alberta, Saskatchewan, and Manitoba). The Peace River Valley, extending from northeastern British Columbia into Alberta, is also an important grain-producing area. Production mostly consists of wheat, barley, oats, and rapeseed. Rye, flaxseed, sunflowerseed, and specialty crops such as dry beans and peas and mustard seed are also grown here. Corn, winter wheat, soybeans, and mixed grains are grown in southern Ontario and Quebec. The Prairie Provinces account for 92 percent of all grain and oilseeds production in Canada and about 98 percent of all grain and oilseeds exports (*30*).[1]

[1]Italicized numbers in parentheses refer to items cited in the References section.

The Prairie Provinces are both sparsely populated and far from sources of cheap water transportation. Western grain moves from its primary production area in the Prairie Provinces to population centers in the east and on the west coast and to export position, at the port of Thunder Bay on Lake Superior, to Vancouver and Prince Rupert on the west coast, and to Churchill on Hudson Bay (fig. 1).

Canada's near total reliance on the rail transport system to move agricultural products differs greatly from that of the United States. Canada has no commercially navigable rivers in the west and its sole inland waterway, the Great Lakes-St. Lawrence Seaway, is located at a great distance from the principal grain-producing area. In contrast to the United States, whose extensive inland waterway systems are located near major grain-producing areas, Canada has no source of low-cost water transportation in the Prairie Provinces. While grain moves over similar distances in both countries, nearly all grain movement in Canada is by rail. Compared to the other major grain-exporting countries, Canada moves its grain over greater land distances to export position. A central point in Saskatchewan (the Province in which approximately 50 percent of all western grain is produced) is more than 2,000 miles from the Atlantic Ocean to the east (although only 900-1,000 miles from the Lake Superior port of Thunder Bay), 1,100 miles from the west coast, and about 800 miles from Hudson Bay (table 1).

Canada's land transportation must traverse a variety of rough terrains. The Prairie Provinces are separated from the west coast by rugged mountains; from Hudson Bay by rock outcroppings, forests, muskeg (swamps or bogs), and permafrost; and from the Great Lakes by the rock, forest, lakes, and muskeg of the Canadian shield (*49*). Freezing conditions limit the use of two of the three major shipping sectors; Churchill is open for only 3 months a year (July through September), and Thunder Bay operates about 8 1/2 months a year (mid-April to late December).

Table 1—Distances from major prairie cities to Canadian ports

Prairie city	Vancouver	Thunder Bay	Churchill
		Miles	
Calgary	640	1,267	1,190
Edmonton	770	1,250	1,160
Regina	1,100	780	830
Saskatoon	1,100	930	790
Winnipeg	1,400	420	950

Source: (*17*).

In 1980, western Canada grew grain and oilseeds on about 157,000 farms, which are widely dispersed over 190,000 square miles. These farms were served by about 3,100 primary (country) elevators located at about 1,250 rail delivery points. The rail grain transportation system must collect vast quantities of grain in small lots from each of these points for delivery to four ports. The delivery points are served by poorly maintained branch lines, many of which can support only light-loaded trains at low speeds. The large number and small average size of these delivery points make collection of large volumes of grain cumbersome and costly.

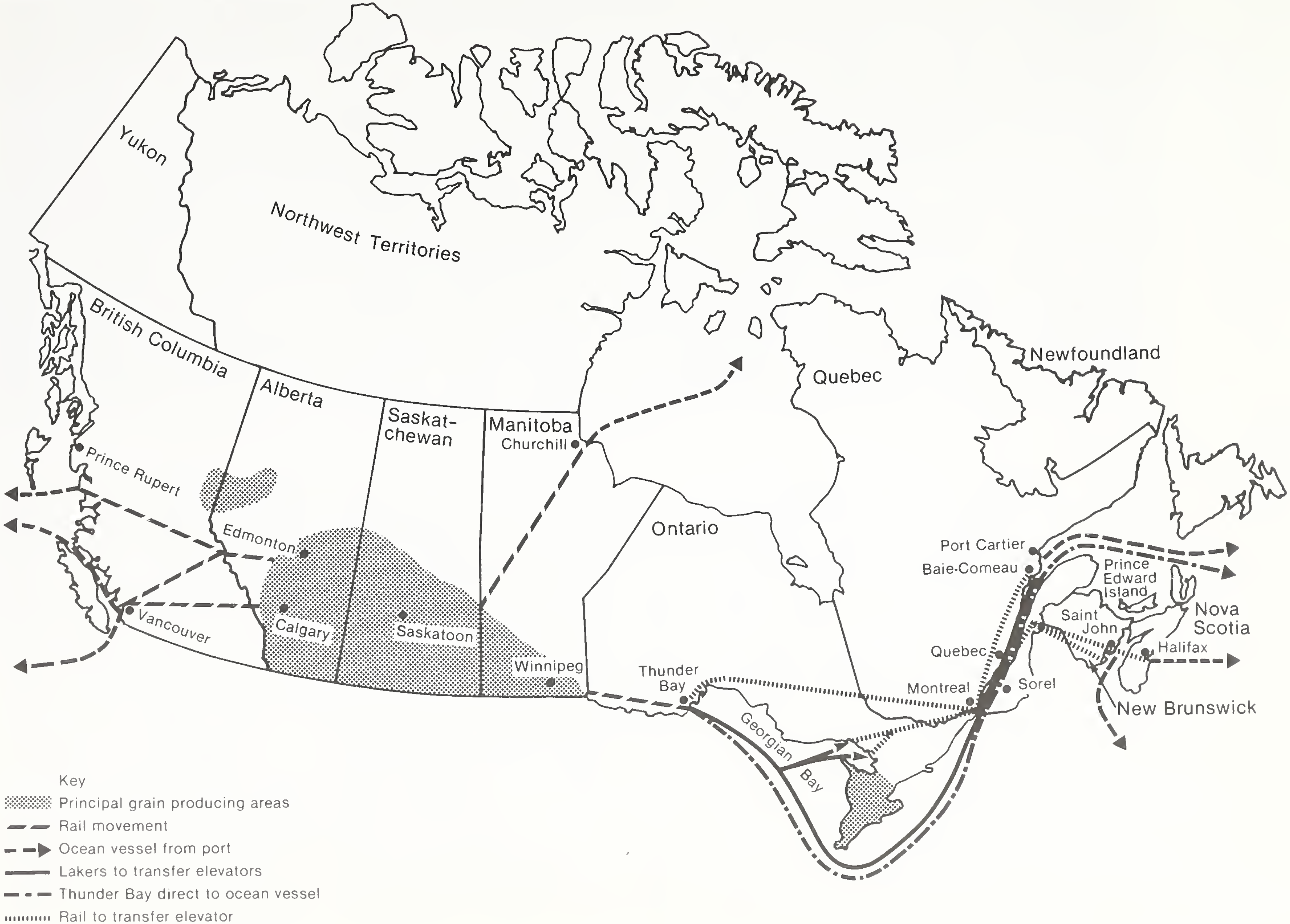
Delivery System

Producers usually deliver grain to country elevators by truck an average distance of 10 miles. The grain is loaded from the elevators to railcars. The railcars are collected, often from several delivery points, at one of 22 distribution yards where they are assembled into trains which then move on the main rail line to one of four large classification yards (two in Winnipeg, one each in Calgary and Edmonton) for final assembly. Trains sometimes head directly to port. Almost all grain moved from the Prairie Provinces is handled by the two largest railways in Canada, Canadian National (CN) Railway and Canadian Pacific (CP) Railway. At port, the railcars are separated, sorted, and delivered to the appropriate terminal elevators, where the grain is elevated, cleaned, and dried if necessary. A limited amount of grain (less than 500,000 tons annual average) is railed or trucked to one of the five inland terminal elevators at Lethbridge, Calgary, and Edmonton in Alberta and Moose Jaw and Saskatoon in Saskatchewan. Grain is processed (cleaned, dried, treated, and stored) for export at these terminals and then moved to port by rail.

At Thunder Bay, unlike the three major ocean ports, most of the grain is loaded to small bulk hauling ships, often referred to as lakers, which move the grain from the lakehead through the Great Lakes and St. Lawrence Seaway to transfer elevators along the St. Lawrence River. Here, the grain is transferred to oceangoing ships. A small amount (10 percent or less) of grain shipped out of Thunder Bay is loaded directly to oceangoing ships. The increasing size of oceangoing bulk ships and the limited St. Lawrence Seaway draft account for the relatively small proportion of ocean-direct shipments from Thunder Bay.

Figure 1

Movement of Grain in Canada



Oceangoing ships must be frequently topped off (loaded with additional grain to capacity) at lower St. Lawrence transfer elevators.

A large amount of grain for domestic use is moved through Thunder Bay. Lakers deposit the grain at process or transfer elevators along the Great Lakes or the upper St. Lawrence River.[2] Small amounts of grain are transported by rail directly from the Prairie Provinces to domestic markets in eastern Canada (*52*). The CWB winter rail export program moves export grain in unit trains from Thunder Bay to lower St. Lawrence transfer elevators at Montreal, Sorel, and Quebec City. Over 1 million metric tons of grain were moved by this route during the winter of 1982-83, although this mode usually averages less than that. A small quantity of grain, generally less than 1 million metric tons annually, is shipped by rail from Thunder Bay to the Atlantic ports of St. John, New Brunswick, and Halifax, Nova Scotia. These two routes bypass the frozen seaway during the winter.

Transportation and Export Growth

World trade in grains and oilseeds grew rapidly during the seventies and is expected to continue growing into the eighties when world population and per capita incomes are expected to rise. The CWB estimated that the world market for wheat could increase to 85 million metric tons and to about 100 million metric tons for coarse grains by 1985.[3] Assuming that Canada maintains a constant share of the world market, the CWB has estimated that the world grain market could absorb Canadian grain exports within the following ranges: wheat, 18 to 22 million metric tons; coarse grains, 7 to 9 million metric tons; and oilseeds, 2 to 4 million metric tons, for a total of 27 to 35 million metric tons (*15*).

Within these ranges, the CWB selected a 30-million-ton export target for western grains and oilseeds by 1985, and a 36-million-ton target by 1990. At the time these projections were made, the 30-million-ton figure represented a 50-percent increase over the previous high of 20 million tons of western grain shipped in 1972/73. In 1981/82, Canada exported 26 million tons of western grains and oilseeds.

Canada's success in increasing grain exports will depend upon the performance of the grain handling and transportation system. The railways, however, are reluctant to expand the grain service because it is unprofitable due to the continued existence of the Crow's Nest Pass rates. These rates were established by law in 1897 as part of an agreement between the Canadian Government and CP Rail. The Government provided a subsidy to build a rail line through the Crow's Nest Pass to exploit the coal deposits in the mountains of southern British Columbia. In return, CP Rail agreed to reduce freight rates on prairie grain for export, and to charge no higher rates in the future. The Government wanted to develop the coal mining industry in British Columbia and to ensure that the coal would move entirely through Canada rather than through an easier route through the United States. It also encouraged agricultural development in the west by reducing freight rates on settlers' effects shipped to the Prairie Provinces from the east and by reducing freight rates for export grain and flour from the Prairie Provinces. Subsequent legislation extended the terms of the agreement to additional grains and destinations. The rates were last adjusted in 1925. The rates for moving statutory grain (grain and certain grain products covered by the Crow's Nest Pass agreement and related statutes) have been kept at the 1925 levels, while costs to the railways for moving statutory grain have continued to rise. The revenue losses incurred by the railways were not offset by any direct subsidy from the Government. The railways have refused to sink funds into capital improvements for the grain service as a result.

Growth in grain exports during the sixties revealed the inadequacy of the rail transport system in terms of grain hauling. The 1961 MacPherson Royal Commission on Transportation, commissioned to examine problems of rail transport in Canada, investigated the railways' claim of losses on grain transport. The commission found in favor of the railways, but its recommendation for a general subsidy was not accepted. The 1967 National Transportation Act paid a subsidy to the railways for unprofitable branch lines operated in the public interest and recommended that the railway be allowed to abandon some branch lines. The 1969 block shipping system and railcar pooling of CWB grain were attempts to improve coordination of grain movements. These measures failed to prevent further deterioration of branch lines and attrition of the grain car fleet, which dropped from 34,000 cars in 1969 to 12,560 cars in 1980 (*30*). Some branch lines became unusable and others could be used only at low speeds.

[2]Process elevators receive and store grain for direct manufacture or processing into other products.

[3]World wheat and coarse grains trade had already exceeded these figures in 1979/80.

World grain trade growth coincided with growing demand for other western Canadian bulk commodities such as coal, potash, sulfur, and lumber. During 1977-79, rail capacity was so tight and Vancouver congestion so great that the CWB could not assure delivery, thus losing an estimated $1 billion in sales (*41*).

The Federal and Provincial governments and the CWB have taken steps to alleviate the crisis in grain transportation capacity. These measures include adding grain hopper cars, paying for upgrading and rehabilitating branch lines and boxcar repairs, and creating the Grain Transportation Authority (GTA) to oversee railcar allocation. Although these programs have increased the handling capacity of the grain handling and transportation system, their potential for further expansion is limited. These efforts do not constitute a comprehensive, system-wide approach to relieving the constraints present in the overall transportation system. They also fail to address the fundamental problem of the grain handling and transportation system: maintaining grain freight rates fixed at unprofitable levels.

Government's Role

From the railways' earliest days, when the Government provided large subsidies for the construction of the first transcontinental rail line, to the present time, when quasi-governmental organizations have much of the responsibility for coordination of grain shipping, the Canadian Government has greatly influenced the development of the grain handling and transportation system. The Government continues to play a role in grain transportation by providing railcars and funds to improve branch lines and through freight rate control and subsidies.

Crow's Nest Pass Rate

The 1897 Crow's Nest Pass Agreement was struck to build the line through the Crow's Nest Pass to exploit coal deposits, to settle the west by lowering rail rates on settlers' effects moving west, and to encourage agricultural production by lowering freight rates on grain for export. The settlers' effects provision was removed in 1925, and, in return, CP Rail agreed to extend the original Crow rates for grain and flour to all points on the company's line. The rates were also extended to apply to all railways operating in the west. In 1927, the statutory rates were extended to export grain moving to the west coast and Churchill. Today, the statutory rates apply to export grain from the Prairie Provinces to Thunder Bay, Vancouver, Prince Rupert, and Churchill and to grain for domestic use as far as Thunder Bay. A sample of the Crow tariff from selected prairie points is shown in table 2. Following are products included under statutory rates:

Wheat	Linseed meal[5]
Barley	Soybean meal[5]
Buckwheat	Sunflowerseed meal[5]
Oats	Flour (from grain or malt)
Rye	Malt
Flaxseed	Rolled oats
Rapeseed	Pot and pearl barley
Corn[4]	Oatmeal
Screenings	Breakfast foods, cereals
Rapeseed meal[5]	

Not included are:

Sunflowerseed	Mustard seed
Rapeseed oil	Lentils
Linseed oil	Peas
Sunflower oil	

The rates as initially set compensated the railways for the costs of moving grain. Because the rates are frozen at 1925 levels, however, they no longer reflect the true costs to the railways of moving grain. The Crow rates have been maintained because policymakers have been convinced that the national interest lies in continuing the production of western grains and that the Crow rates are necessary to ensure that prairie grain producers remain competitive with producers of grain in other countries. Grain exports contribute to the well-being of the Canadian economy as a major foreign exchange earning activity. Only recently has a consensus for changing the Crow rates developed, as western grain producers have come to realize that increasing their grain sales will depend on the viability of rail transport.

The Crow rates have created problems for the grain handling and transportation system. Because of losses incurred on grain transportation, the railways have been unwilling to invest further in grain transportation facilities such as branch lines used solely to transport grain, box cars used in grain rail movement, and grain hopper cars. Grain rail service has suffered as a result. The railways have stopped adding rolling stock for grain movement

[4]To Thunder Bay and Churchill only.
[5]To Thunder Bay only.

Table 2—Crow's Nest Pass tariff for rail movement of grain from selected prairie origins[1]

Origin	Destination	Distance	Rate
		Miles	*Cents per 100 lbs.*
Winnipeg, Manitoba	Thunder Bay	420	14
	Churchill	978	23
Moose Jaw, Saskatchewan	Thunder Bay	819	20
	Vancouver	1,067	25
	Prince Rupert	1,475	25
	Churchill	885	22
Saskatoon, Saskatchewan:	Thunder Bay	899	22
	Vancouver	1,088	24
	Prince Rupert	1,280	24
	Churchill	815	21
Regina, Saskatchewan	Thunder Bay	777	20
	Vancouver	1,108	26
	Prince Rupert	1,437	26
	Churchill	844	22
Calgary, Alberta	Thunder Bay	1,244	26
	Vancouver	642	20
	Prince Rupert	1,185	20
	Churchill	1,214	26
Edmonton, Alberta	Thunder Bay	1,244	26
	Vancouver	765	20
	Prince Rupert	957	20
	Churchill	1,138	25

[1]Freight rates for rapeseed, flaxseed, and products covered by statute are 1.5 cents higher.

Source: (*48*).

and have also delayed main line improvements until additional funds for grain transport are forthcoming. CP Rail has delayed building a tunnel in the Rogers Pass area, the most serious bottleneck on the CP mainline to Vancouver (*27*). CN Rail has warned that, without more revenue from grain traffic, rail capacity expansion projects are threatened and rationing of existing rail capacity will be necessary.

The MacPherson Commission recommended that the railways be compensated for losses incurred in the carriage of statutory grain. This recommendation was not acted upon, however, and as costs of providing service rose, the railways' losses on the grain portion of their operations mounted. In 1974, a commission appointed by the Canadian Government investigated the costs and revenues associated with the movement of statutory grain (*23*). The commission found that 1974 costs of transporting statutory grain were 2.58 times the revenues received from grain shippers. When the branch line subsidy was included in grain revenues, the railways' costs for moving grain were 1.63 times the revenue received. This discrepancy between costs and receipts is called the "Crow gap" by the railways and the "Crow benefit" by the farmers.

The commission determined that revenues received from users of the service covered only about 39 percent of the costs of moving statutory grain in 1974, the Federal Government's contribution covered about 22 percent, and the remaining 39 percent was covered by the railways themselves from revenues received for transportation of other commodities (table 3). More recent (1981) estimates put costs of moving grain at four to six times the revenue received from users on a per bushel basis (*45*). From 1974 to 1980, the user's contribution to costs fell while the Government's share rose. "Other contributors," probably railway shareholders and shippers of other commodities, continued to bear most of the costs of moving grain.

A number of plans to change the Crow rate and put the railways' grain service on a sound financial basis have been proposed. These include paying the difference between the Crow rate and the compensatory rate to the railways out of the Government's general fund, per-

Table 3—Coverage of costs incurred by railways in transporting statutory grain

Item	1974	1977	1980
		1,000 dollars	
Amount of cost coverage:			
User revenues	89,717	114,764	132,873
Federal Government payments	54,364	78,638	170,166
Other contributors	103,028	160,536	244,441
Total	247,109	353,938	547,480
		Percent	
Distribution of cost coverage:			
User revenues	36.3	32.4	24.3
Federal Government payments	22.0	22.2	31.1
Other contributors	41.7	45.4	44.6
Total	100.0	100.0	100.0
Ratio of costs to user revenues	2.75	3.08	4.12

Source: (*45*).

mitting the rates to rise to compensatory levels and paying the amount of the "Crow benefit" to the farmers with some sharing of future cost increases by all parties, or paying the Crow benefit to the railways, with slower rates of increase in freight rates to grain shippers.

Most proposals have met with resistance from western farm groups who regard the Crow benefit as their historic right because the rates were established "in perpetuity." Many western farmers object to changing the Crow rates because they believe the railways to be monopolists and are skeptical that rail service will be improved with increased compensation. Many westerners believe that the Crow subsidy is one of the few regional advantages favoring the west, offsetting tariff policies which favor eastern industry while making agricultural implements and other purchased inputs more expensive to western producers. Because of the land distances involved in moving grain to port, some believe that a freight subsidy program is necessary to enable Canada's grain producers to remain competitive.

Feed Freight Assistance

Another form of freight rate control on grain movement is the Feed Freight Assistance program. This program began during World War II to promote livestock production and reduce western wheat surpluses by encouraging feed grain production and use. The program equalized feed grain prices in eastern and western Canada by paying a subsidy on the transportation of feed grains from Thunder Bay to points east (feed grains move at the Crow rate from the Prairie Provinces as far as Thunder Bay), and from points in the prairies to British Columbia (*37*). Since the subsidy only applies to feed grain movement and not to movement of livestock and livestock products, it encourages shipment of feed grains rather than livestock and livestock products. The program has been criticized, primarily by western livestock producers, for favoring livestock production in the east instead of the prairies which, as the major feed grain producing area, are presumed to have a natural locational advantage in livestock production.

The Feed Freight Assistance program was substantially altered in 1976 when the Federal Government eliminated or reduced subsidies for feed grain movement to Ontario and western Quebec and reduced the level of subsidy to British Columbia. Most of the rates into eastern Quebec and the Maritime Provinces were left unchanged.

At and East Subsidy

The At and East subsidy is a payment to the railways by the Federal Government in return for rate concessions on eastbound export grain and flour. The subsidy was structured to enable western Canadian grain to move to eastern ports at rates competitive with the rail movement from Buffalo to the U.S. eastern seaboard ("At and East of Buffalo"). The subsidy applies to movement of grain from

an inland port (Thunder Bay and most inland ports east of Thunder Bay) to export position at Atlantic or St. Lawrence ports. The rate charged to the grain shipper is frozen at 1960 levels for grain and at 1966 levels for flour. Since 1966, the Government has paid the railways the difference between that rate and the compensatory rate as estimated by the Canadian Transport Commission.

The At and East rate has been used primarily to move export grain by rail to the Atlantic ports of Halifax, Nova Scotia, and St. John, New Brunswick, during the winter months. However, it is possible that, if seaway tolls continue to rise, the At and East route could become a more attractive alternative to the Great Lakes-seaway route, even in nonwinter months. The At and East subsidy has benefited grain producers in both westem and eastem Canada as well as the flour milling industry, since flour movement is subsidized as well as raw grain. However, the At and East rate may have inhibited the development of alternate, and perhaps more efficient, routes such as direct rail movement of grain from the prairies to eastem ports in unit trains.

Effects of Freight Rate Programs

The Crow rate has been criticized for its role in distorting the pattem of economic activity in western Canada. A subsidy on the movement of export grain favors production of grain at the expense of other activities.[6] As a result, more resources are concentrated in grain production than would be the case in the absence of a subsidy. Customers in the export market benefit from the low freight rates. Importers of Canadian grain are thus able to bid up the price to obtain supplies if necessary. Therefore, local users of prairie grain—livestock feeders, millers, and oilseed crushers—pay higher prices for grain than they would otherwise because they must compete with the favored export market for grain supplies. Any price advantage to local grain users that would normally derive from being located near the source of supply is eroded by the artificially low transportation rate.

The Crow rate produces higher farm gate prices for export grain because the freight rate deduction from the world price at export position is lower. Grain for local use is also higher priced than it would otherwise be because customers must compete with the export market for available supplies. As a result, development of secondary processing industries, such as crushing, refining, milling, meat packing, and food processing, has been hindered. The Crow rate has also resulted in the production of more statutory grain in the west and less specialty crops, such as sunflowers, lentils, peas, and beans. More grain is produced than if there were no subsidy; less livestock is produced because it is more expensive to feed locally produced grain. A combination of the Crow rate, which applies to movement of grain for domestic use as far as Thunder Bay, and Feed Freight Assistance has encouraged cattle feedlot operations and hog production in the east at the expense of western operations.

The Crow rate and the moratorium on branch line abandonment have adversely affected development of the trucking industry. The low statutory freight rates encourage shipping by rail and are now so low relative to costs that trucks cannot profitably compete. The overbuilt branch line network made rail shipping convenient to farmers and prevented trucks from taking over short hauls of grain, where trucks have the greatest advantage over rails. Consolidation of large numbers of small primary elevators has also been delayed by retaining the large number of branch lines.

The statutory freight rates have also been largely responsible for declining rail service for grain shippers. Grain shipping is a high-cost service, drawing grain in small lots from many delivery points, and one on which the railways lose money because of the Crow rate gap. The revenue shortfall has led the railways not only to neglect grain-related branch lines but also to delay main line improvements. The administered freight rates have also prevented development of more efficient means of providing rail service by impeding the railways' ability to offer rate incentives for volume shipments. Because the Crow rate also applies to movement of grain for domestic use as far as Thunder Bay, some eastem industries, notably oilseed crushing and livestock feeding, are believed to have an unfair advantage over their westem counterparts.

The freight rate differential between rapeseed and its products puts the western rapeseed crushing industry at a disadvantage relative to its eastern counterpart. Raw rapeseed for export moves at Crow rates as does rapeseed for domestic use as far as Thunder Bay. Rapeseed oil and rapeseed meal, however, are charged, for the most

[6] While no direct subsidy payment is currently made by the Government to the railways or to producers for movement of statutory grain, the Crow rate is a subsidy in the sense that any time a user of a service is charged less than the true costs of providing that service, use of the service is subsidized.

part, commercial rates. The disadvantage to the western crusher is further compounded by the effect the freight rate structure has on the pricing system. Rapeseed, like wheat, is priced at export position at Vancouver. Therefore, western crushers must pay the Vancouver price less the low statutory freight rate to Vancouver. However, the prices for its products, meal and oil, are determined by the eastern Canadian price for soybean meal and oil with some adjustment for the different protein contents of the respective meals. The price received by the crusher for rapeseed products is therefore based on the eastern price, less a higher deduction for freight between eastern markets and the western crushing plants. The price the crusher pays for locally available raw material is higher because the freight deduction from the Vancouver price is lower (*42*).

Producers' Role

Producers decide what to grow and how much, and whether and when to deliver the product to the elevator or to store it on the farm. CWB actions may influence these decisions, although it has no explicit supply-management responsibility.

The CWB is the sole marketer for wheat, oats, and barley produced in the Prairie Provinces for export. Certain interprovincial deliveries are also under CWB jurisdiction. Elevator companies receive board grains (grain whose sale is governed by the CWB) as agents of the CWB. At the time of delivery, producers receive partial payment for the grain in the initial payment. The initial payment is set by the CWB, usually prior to spring planting and presents the CWB's assessment of market conditions for the coming marketing year. The initial payment is the same throughout the year for each type and grade of grain and acts as a *de facto* floor price, since the announced price is guaranteed by the Government. If market conditions are particularly strong, an additional, interim payment may also be announced during the crop year. When CWB accounts are closed, that is, when the all board grain delivered during the crop year has been sold, a final payment is made.

All board grain delivered during the crop year enters a pool; that is, it is treated without distinction as to origin or time of delivery. Receipts from the sale of grain are similarly pooled, and, at the close of the pool year, the producers receive a final payment that reflects the difference between the initial payment and the actual receipts. Price pooling gives each producer an equitable share of the realized earnings based on the volume delivered. By pooling receipts, the CWB ensures that all farmers receive the same price for their board grain. To encourage more uniform delivery of grain throughout the year, the CWB operates a delivery quota system. It announces how much grain it will accept from producers in a certain region. The quota is based on each producer's past acreage. The delivery quota system gives the CWB some measure of control over grain deliveries to the elevator. However, the quota only provides producers the opportunity to deliver. CWB control of grain deliveries is therefore indirect.

The producers' important role in the grain handling system begins with providing onfarm storage of grains. The commercial elevator system can hold only a portion of the total grain crop at any time and thus its storage capacity must be supplemented. Storing grain on the farm rather than in country elevators effectively expands the working capacity of the grain distribution system. Onfarm storage is generally cheaper than storage in country elevators and leaves commercial elevators free for pipeline storage, emptying clogged elevators. Onfarm storage is also a stock which can be drawn down in times of large increases in demand.

Producer delivery decisions are based on what is allowed under the delivery quota system. Farmers may deliver their grain at any time before the end of the terminating quota, wait until another quota is announced, or in the case of nonboard grains, continue to store it in anticipation of a better price. Farmer delivery opportunities are limited by weather and the demands of the planting and harvesting seasons. Despite the delivery quota system, grain deliveries tend to peak in June, July, and September. Producers usually wait to deliver until near the end of the crop year when they have a better idea of the condition of the current year's crop. Deliveries may increase toward the end of the crop year because producers want to move their grain before the end of the pool year for board grains, and to make onfarm storage available to accommodate the upcoming harvest. Deliveries peak again in postharvest September in order to make room for the harvested crop, to deliver from the combine to the elevator to avoid farm storage, and to provide a cash flow to producers.

There are few incentives to encourage more uniform flow of grain from farm to elevator (*4, 9, 10*). To the extent that grain deliveries to primary elevators are concentrated

in a few months, more physical storage capacity is required to accommodate the peaks. Off-months find facilities underutilized. Equity considerations built into the CWB price-pooling system do not provide incentives for timely off-peak deliveries. Greater incentives could encourage more onfarm storage and grain drying to reduce the need for these facilities at commercial elevators and to increase elevator throughput.

The producer car system allows producers to order their own railcars to ship grain by rail, subject to the prevailing grain delivery quota and to the 100-car per week limit imposed by the Canadian Grain Commission (CGC). Producers must find buyers for their grain, must arrange for licensed companies or grain dealers to handle the loading documents, and must apply in writing to the CGC for a car. By loading grain directly to railcars, producers gain a certain measure of independence from the railways and avoid elevator fees, although an administration fee is charged.

Producers receive receipts for their grain at the time of delivery after adjustments for dockage, a deduction for broken kernels or foreign matter in the grain. However, most country elevators do not have grain cleaning facilities, so the grain must be cleaned at terminal elevators. The byproduct of the cleaning process is screenings, a low-quality feed. Producers receive no compensation for the screenings, which are sold for profit by the terminal elevator company. The CWB assesses a charge for moving screenings, which is included in the elevator tariff charged to the producer. This charge is assessed without regard to whether the grain is high in dockage or relatively clean. Critics of this procedure have suggested that changing the elevator tariff structure to reflect the true cost of transporting high dockage grain versus clean grain would encourage shipping clean grain *(10)*. This would relieve grain-cleaning bottlenecks at port and would result in a more efficient use of the transportation system.

The Elevator Grain Handling System

Assembling, cleaning, drying, blending, storing, and distributing grain is carried out by the elevator system which consists of different types of elevators performing different functions. Primary or country elevators collect grain from producers, assemble it into carlots, and load it to railcars. Process elevators handle and store grain as part of a milling or other grain processing plant; these elevators receive raw grain and oilseeds from rail, truck, or ship and store it for further processing. Terminal elevators are large elevators which receive grain from rail shipments for export and have facilities for cleaning, drying, and blending grain. Although generally located at ports, five inland terminals operate in Alberta and Saskatchewan and function the same as port terminals except for loading grain to ships. Inland terminals load cleaned grain to railcars for overland transport to ports. Transfer elevators receive grain from lakers and store it for transfer to oceangoing ships. These elevators are located along the lower St. Lawrence River.

Elevators also provide temporary off-farm storage for grains and oilseeds. They augment the primary onfarm storage and permit the marketing system to respond to new sales opportunities by holding grain inventories which can be drawn on quickly. Table 4 shows licensed elevator storage capacity by elevator type. At any one time, however, the elevator system can store only a fraction of total Canadian grain and oilseed production. This capacity is further reduced by the need to separate grain by type and grade, and by the space occupied by U.S. grains in St. Lawrence transfer elevators. However, fewer prairie primary elevators means that the elevator system will be able to store less grain; as grain production increases, elevators will have to turn over grain stocks more frequently.

Primary Elevators

Primary, or country, elevators link producers and the railways by collecting grain from producers, assembling it into railcar loads, and shipping it out of the producing areas to domestic purchasers or to terminal elevators for export. As part of this function, the elevator companies act as agents of the CWB by accepting grain from producers, weighing and grading it, and giving the producer a cash ticket for the grain. Primary elevators also store grain temporarily for producers who do not wish to sell immediately. They may also sell supplies to producers.

Producers generally deliver grain to the primary elevator by truck. The grain is weighed, graded, and elevated based on a sample taken by the elevator operator. Producers receive cash tickets according to the weight and grade of the grain, with deductions for elevator tariffs, freight, and dockage. Producers have the right to receive an official grade for the grain from the CGC if they do not agree with the grade assigned by the elevator manager.

Table 4—Off-farm storage, licensed capacity[1]

Grain storage position	Crop year			
	1975/76	1976/77	1977/78	1978/79
	1,000 metric tons			
Primary elevators	9,954	9,629	9,316	9,245
Process elevators	544	576	577	584
Terminals including five inland terminals	3,944	3,901	3,655	3,544
Other (transfer)	3,426	3,412	3,426	3,485
Total	17,868	17,519	16,974	16,858
	1979/80	1980/81	1981/82	1982/83
Primary elevators	9,053	8,749	8,506	8,138
Process elevators	581	602	569	548
Terminals (including five inland terminals)	3,587	3,695	3,695	3,695
Other (transfer)	3,527	3,586	3,582	3,690
Total	16,748	16,632	16,353	16,071

[1]Items may not sum to totals due to rounding.

Source: (*16*).

Elevators are usually owned by a producer cooperative or a grain company. While elevator companies do not profit directly from the sale of board grain, they earn revenues from elevation charges and other services they provide producers. Two or more elevators located at the same delivery point may be run as an operating unit by a single operator.

Most primary elevators are located along rail lines. A fundamental change in the structure of the primary elevator industry has coincided with branch line rehabilitation and abandonment. Elevator numbers, operating units, delivery points, and elevator storage capacity all have declined since the fifties, caused by the closing of high-cost, isolated, and obsolete elevators and investment in larger, more efficient high-throughput structures to take advantage of economies of scale and reduce labor costs. Company mergers have also contributed to the consolidation of primary elevators. The number of primary elevator companies has also fallen from 166 at its peak to the current level of 8 (49). However, average capacity per operating unit and per delivery point has increased over the 30-year period. The seventies, a decade of rising grain exports, saw the number of primary elevators drop by 30 percent and total storage capacity drop by about 20 percent.

The pace of consolidation accelerated in the last half of the decade. Primary elevator numbers have been declining since the midfifties but storage capacity peaked in the early seventies (table 5). Since 1970/71, 3 million tons of storage capacity left the system, a loss of slightly more than 25 percent of the 1970 licensed capacity. The elevators remaining in the system are, on the average, larger, more geographically dispersed, and concentrated in fewer hands. All measures of average capacity have risen as the number of operating units has declined by half since 1965/66. The number of delivery points has also dropped. The decline in the number of operating units reflects the mergers and the drop in delivery points indicates the impact of rail line abandonment on primary elevator consolidation.

Fewer elevators and less capacity in the system mean that the remaining elevators will have to be more efficient to move the larger volumes of grain that Canada plans to ship without creating a new source of congestion. The elevators being removed from the system are generally unprofitable or located on low-volume lines. Sidings, or rail loading tracks alongside country elevators, will have to be lengthened at some elevators to permit more cars to be loaded at one time. Although there are fewer stations, many old, small elevators are being replaced by new, high-throughput (10,000 to 25,000 bushels) elevators which are larger, can receive and load grain faster, and can process more grain and load more railway cars.

The trend toward elevator consolidation will help improve scheduling and coordinating grain movement be-

Table 5—Primary elevator data

Year as of August 1	Licensed elevators in service	Delivery points[1]	Operating units[2]	Licensed elevator capacity[3]	Average elevator capacity	Average capacity, operating unit	Average capacity, delivery point
	------ Number ------			-------------- Metric tons --------------			
1950	5,309	2,139	NA	7,926,910	1,493	NA	2,710
1955	5,367	2,083	NA	9,666,870	1,801	NA	4,740
1960	5,299	2,068	NA	10,130,670	1,912	NA	4,890
1965	5,139	1,983	4,062	10,674,020	2,077	2,620	5,380
1970	4,971	1,907	3,539	11,167,320	2,246	3,150	5,850
1975	4,165	1,556	2,623	9,954,480	2,390	3,790	6,330
1976	3,964	1,495	2,546	9,630,390	2,607	3,780	6,440
1977	3,739	1,417	2,467	9,317,170	2,492	3,770	6,570
1978	3,658	1,394	2,440	9,245,450	2,527	3,790	6,630
1979	3,528	1,351	2,376	9,052,740	2,566	3,810	6,700
1980	3,324	1,295	2,162	8,748,630	2,632	4,047	6,755
1981	3,133	1,246	2,075	8,506,780	2,715	4,100	6,827
1982	2,934	1,217	1,975	8,137,700	2,773	4,121	6,686

NA = Not available.
[1]Railway stations.
[2]Two or more primary elevators operated as a single unit by a grain company at one location.
[3]Refers to standing capacity.

Source: (*16*).

cause grain will be brought from fewer points in the prairies. As the size of primary elevators increases, mechanization and unit train operations will likely increase.[7] The industry's economic health will be enhanced as costs are reduced by mergers and closings of obsolete operations and by increased earnings from individual elevator's greater storage capacity.

When rail lines are abandoned, primary elevators usually close or consolidate, promising even greater efficiency in handling grain by the larger remaining elevators. Primary elevator consolidation which occurs for economic reasons should also lead to further abandonment of branch lines. Primary elevator consolidation and rail line abandonment will mean longer trips from the farm to the elevator for some producers. The average trip length from farm to country elevator, growing from 7 miles in 1972 to 12.3 miles in 1980, will increase further. The new high-throughput primary elevators will be spaced farther apart (about 25 to 30 miles) compared with the current pattern of elevators located 8 to 10 miles apart according to the Hall Commission, which studied the effects of branch line closures (*33*). Some producer groups fear that consolidations will impede competition among elevators, leading to higher elevator charges to farmers. This fear is probably unfounded, because elevator companies are restricted in their ability to increase charges by the CGC which sets a ceiling on tariffs that elevator companies may charge. If the trend toward fewer and larger elevators produces more efficient operation of the grain handling system, higher volumes of grain moved, and reduced congestion, opportunities for the farmers to deliver their grain should improve, albeit at a cost of longer trips to the elevator for some producers.

Inland Terminal Elevators

Grain for export may be cleaned, weighed, and officially inspected and graded at inland terminals. Inland terminal elevators may take pressure off congested port terminals, particularly Vancouver (*33*). Five inland terminals, together capable of holding almost 480,000 metric tons of grain, are owned by the Provincial Government of Alberta and private firms. The terminals and their capacities are Moose Jaw, Saskatchewan, 154,020; Saskatoon, Saskatchewan, 154,020; Calgary, Alberta, 70,010; Edmonton, Alberta, 65,810; and Lethbridge, Alberta, 35,100 (*16*). Because grain cleaning capacity is a major bottleneck at Vancouver, interior terminals could be used more to clean grain to export standards, as well as dry, grade, and store grain for shipment to any of the western ports. Inland terminals could provide reserve storage capacity in times of peak demand.

[7]A unit train is a large train whose cars all carry the same type of commodity, moving as a unit from origin to destination.

Inland terminals have not operated to full capacity; stock turned over only about twice yearly in the inland terminals, compared with an industry average of 12 times a year. They have had a difficult time competing with port terminals because railways assess stopoff charges for in-transit grain held for storing, cleaning, or drying. Grain companies generally prefer to use their own port facilities to maintain revenues realized from these services as well as sell screenings to the lucrative export market. Inland terminals could assemble grain in large enough quantities to make unit train operations feasible, which would be a more efficient use of railcars, engines, and track.

Transfer Elevators

Transfer elevators receive grain from either trains or ships. The grain is officially weighed, inspected, and graded at a terminal elevator, and loaded onto oceangoing ships or to railcars. Some transfer elevators also clean and store eastern or foreign grain. The busiest transfer elevators are at Sorel, Montreal, Quebec City, Trois Rivieres, Port Cartier, and Baie Comeau in Quebec Province (table 6). Rail-to-ocean ship transfers are a large part of the operations at Montreal and Quebec City during the winter. The transfer elevators along the lower Great Lakes, Lake Huron's Georgian Bay, and the upper St. Lawrence River in Ontario Province have lost business since the enlarging of the Welland Canal and the opening of the St. Lawrence Seaway (table 6). However, a few of these elevators transfer grain from lakers to railcars during the winter months when seaway traffic shuts down. Many of these elevators now mostly handle eastern grains such as corn, soybeans, wheat, and other feed grains.

Transfer elevators at Port Cartier and Baie Comeau are large, relatively new, and highly automated. They can load and unload ships rapidly at the mouth of the St. Lawrence River, saving today's larger ocean ships the considerable expense of sailing further upriver. Another large transfer elevator will be built at Gros Cacouna, Quebec, and should be completed in the mideighties.

The St. Lawrence transfer elevators ship 45 percent of Canada's grain exports each year (between 8 and 12 million tons), and also handle between 4 and 7 million tons of U.S. grain (table 7). The CGC regulates the amount of U.S. grain stored in these elevators. No more than 40 percent of elevator storage may be occupied by U.S. grain at any one time, although throughput may be higher.

Table 6—Licensed transfer elevators at lower St. Lawrence ports, Great Lakes, Georgian Bay, and upper St. Lawrence ports

City and ownership	Licensed capacity
	Metric tons
Lower St. Lawrence:	
Montreal—	
National Harbours Board, No. 1	112,020
National Harbours Board, No. 3	140,020
National Harbours Board, No. 4	262,020
National Harbours Board, No. 5	142,820
Sorel, Sorel Elevators Ltd.	146,460
Trois-Rivieres, Three Rivers Elevators Ltd.	167,380
Quebec City, Bunge of Canada Ltd.	224,030
Baie Comeau, Cargill Grain Co., Ltd.	469,840
Port Cartier, Port Cartier Elevator Co.	292,980
Great Lakes, Georgian Bay, and upper St. Lawrence:	
Port McNicoll, Marathon Realty Co., Ltd.	182,030
Midland—	
Canada Steamship Lines, Ltd.	74,210
Maple Leaf Mills, Ltd.	119,020
Midland (Tiffin), (CN Railway Co.)	126,550
Owen Sound, Great Lakes Elevator Co., Ltd.	112,020
Goderich, Goderich Elevators, Ltd. (2)	128,820
Sarnia, Maple Leaf Mills, Ltd.	151,220
Collingwood, Collingwood Terminals, Ltd.	56,010
Windsor, United Co-Operatives of Ontario	56,010
Port Colborne—	
Robin Hood Multifoods, Inc.	59,650
National Harbours Board	84,010
Maple Leaf Mills, Ltd.	63,010
Toronto, Toronto Elevators Ltd.,	112,020
Kingston, Canada Steamship Lines, Ltd.	65,810
Prescott—National Harbours Board	154,020

Source: (*16*).

Table 7—Transshipments of U.S. grain through Canada via St. Lawrence transfer elevators[1]

Year	Volume
	1,000 metric tons
1975	2,986
1976	2,985
1977	3,200
1978	5,403
1979	6,171
1980	7,350
1981	6,356

[1]Includes wheat, rye, barley, oats, corn, and soybeans.

The Atlantic port grain facilities at Halifax, Nova Scotia, and St. John, New Brunswick, are also classified as transfer elevators. The Halifax National Harbours Board facility has 144,290 metric tons of capacity while the three St. John facilities have the following capacities: Canadian National Railway Co., 13,608; Marathon Realty Co., Ltd., 27,216;

and Maple Leaf Mills, Ltd., 44,160 (*16, 17*). During the winter, they are the main outlet for export grain in the eastern sector. These elevators receive grain by rail from Thunder Bay or the lower Great Lakes elevators and load it to oceangoing vessels. These shipments generally total less than 1 million metric tons per year and comprise a relatively small share of total exports, between 3 and 4 percent since the midseventies.

Terminal Elevators

Principal functions of terminal elevators are the movement of grain from railcars to ships, the conditioning (cleaning, drying, grading, and blending) of grain in the elevator, and, to a lesser extent, grain storage in anticipation of sales. The terminal elevators are located at the ports of Thunder Bay, Vancouver, Prince Rupert, and Churchill in addition to the five inland terminals (table 8). A large (200,000-ton licensed capacity), modern, high-speed grain terminal complex, under construction at Prince Rupert, may open by 1985.

Terminal elevators are at times the locus of major bottlenecks in the Canadian grain handling and transportation system. Ship and railcar arrivals are difficult to synchronize, causing grain stocks to accumulate in the elevator and delaying railcar unloading at port while waiting for the purchaser's vessel to arrive. Or, vessels may be kept waiting for the right grain to arrive at the elevator. Grain cleaning may also create congestion and delays at the terminal. Canada's export grain standards are among the most stringent in the world, sometimes requiring several passes of grain over the cleaning screens. Because railcars can be unloaded much faster than grain can be cleaned, loaded railcars may sit in the port yards several days. The United States allows more dockage and adjusts prices accordingly. Higher foreign matter tolerances relieve the elevator system of the considerable burden of cleaning grain to Canadian standards.

Table 8—Terminal elevator capacity, 1981/82

Port	Licensed capacity
	Metric tons
Churchill	140,020
Vancouver:	
Pioneer Grain Terminal, Ltd.	108,000
Saskatchewan Wheat Pool	237,240
Alberta Wheat Pool	282,830
Pacific Elevators Ltd.	199,150
United Green Growers (UGG), Ltd.	102,070
Subtotal	929,290
Prince Rupert	63,010
Thunder Bay:	
Cargill	176,020
Manitoba Pool Elevator No. 1	167,460
Manitoba Pool Elevator No. 3	215,630
Parrish & Heimbecker Ltd.	47,600
Richardson Terminals	210,030
Saskatchewan Wheat Pool #4	223,180
Saskatchewan Wheat Pool #6	169,140
Saskatchewan Wheat Pool #7	362,650
Saskatchewan Wheat Pool #8	70,160
Saskatchewan Wheat Pool #15	119,670
United Grain Growers "A"	231,030
United Grain Growers "M"	91,010
Subtotal	2,083,580
Total	3,694,760

Source: (*16*).

Lack of storage capacity for the grain being delivered can also trigger delays, a particularly troublesome problem in Canada because the large number of grades requires many bins, reducing the amount of usable storage. Export standards are established for "three grades of spring wheat, two grades of utility wheat, five grades of amber durum wheat, and two grades of barley. Provision is also made for segregation of the top two grades of spring wheat by protein level...[At least 3 levels of protein are identified for #1 CWRS wheat and at least 2 levels for #2 CWRS]...In addition, ...six other grades exist for wheat, eight grades for oats, five grades for barley, five grades for rye, four grades for flax and three grades for rapeseed," according to the Canada Grains Council (*10*). Within grades, tough and damp grain is further separated. Critics of the system have argued that separating grain to the extent of the Canadian system may be too costly to justify (*29*).

Terminal elevators operate at Canada's four major grain ports: Thunder Bay, Vancouver, Prince Rupert, and Churchill.

Thunder Bay. The largest grain port is Thunder Bay, located on the northwestern shore of Lake Superior, at the western terminus of the Great Lakes-St. Lawrence Seaway. Thunder Bay joins the western land transport system and the eastern water route. Its 12 elevators handle about 50 percent of the grain exported from Canada. All grain is brought to the port's terminal elevators by rail. Thunder Bay has 230 miles of marshaling yards capable of storing 10,000 railcars, and terminal elevator track capable of spotting an additional 1,044 cars (*8, 4*). The terminal elevators at Thunder Bay currently handle about 15 million tons of domestic and export grain per year (*11*).

Thunder Bay elevators can handle an estimated 18 to 20 million tons per year.

Delays at Thunder Bay may result from shifting, or moving ships, from terminal to terminal. Shifting occurs because elevators often do not have enough grain of the type and grade required to make a full cargo. Delays may also result in railcar loading because the railways deliver cars 7 days a week while terminals operate only 5 days per week.

While most of the grain is shipped out of Thunder Bay on lakers, some oceangoing ships are also loaded. These direct-to-ocean vessel shipments account for about 10 percent of all Thunder Bay shipments and are primarily nonboard grains. Some importing countries maintain a fleet of ships which can navigate the seaway; these countries, wishing to conserve foreign exchange, prefer to send their own ships to pick up grain. Oceangoing ships are frequently loaded to seaway draft at Thunder Bay, then topped off to maximum capacity at one of the St. Lawrence elevators. Direct shipments are not expected to grow and, in fact, have declined in the past several years, because oceangoing ships are larger, making navigation on the St. Lawrence Seaway impossible, and because the rising operating costs of oceangoing ships make it more economical to pick up grain at the St. Lawrence transfer elevators.

Thunder Bay operates for about 8.5 months per year, closing in December when the seaway freezes. The CWB operates its winter rail export program during the winter. Under this program, export grain is moved primarily in unit trains from Thunder Bay to the St. Lawrence ports of Montreal, Quebec City, and Sorel. Export grain is also moved into position during the open navigation season by ship from Thunder Bay to transfer elevators on the upper Great Lakes and Georgian Bay. This grain is then railed from these ports or from Thunder Bay to the Atlantic ports for export. Trains also carry domestic grain either from Thunder Bay or directly from the prairies during the winter. Movement via the winter rail route is favored by the At and East subsidy on rail freight rates. These shipments are a small part of total grain exports but could become a more important outlet for Canadian grains, particularly as shipping costs rise on the St. Lawrence Seaway. This route involves increased handling costs, however, since grain must be transferred from rail to elevator at Thunder Bay, from elevator to ship, from ship to transfer elevators at Georgian Bay, from transfer elevators to rail, and from rail to Atlantic port elevators. As a result, this route is not likely to compete with seaway shipping soon.

Icebreakers could be used to extend the seaway shipping season by 1 month or more, which would increase Thunder Bay export capacity. However, the length of the shipping season alone is not the major constraint on throughput capacity. The linkages between Thunder Bay and the St. Lawrence elevators, particularly the laker fleet and the Welland Canal, will restrict higher volumes of grain from moving through this sector.

Vancouver. The port of Vancouver, on the Pacific Coast, is Canada's second largest outlet for export grain. Vancouver's share of grain exports grew from 35 percent in the midseventies to 40 percent in 1981-82, reflecting the growth of the Pacific Rim markets for Canadian grains and oilseeds.[8] This growth has produced some problems. As recently as 1977/78, when grain deliveries clogged the port, export sales were deferred by the CWB until the following year because delivery could not be assured. Since that time, an additional 270,400 metric tons of storage capacity have been added at Vancouver with the opening of a new terminal and annexes to two existing terminals.

Vancouver exports all of the major Canadian grains in addition to other bulk commodities and merchandise. Vancouver is Canada's busiest port in total tonnage of cargo handled. In 1978, for example, Vancouver handled over 45 million metric tons of cargo, twice as much as the next busiest port, Sept-Iles, Quebec, which ships iron ore almost exclusively. Montreal, Quebec, and Halifax were distant runners-up, each handling about 20 million metric tons each (*46*).

Vancouver's success as a port may have, in some sense, contributed to its grain handling difficulties. Port congestion may still worsen with the expected growth in exports from the nonagricultural sector. The port area in Vancouver surrounds one inlet with little room for expansion. Urban congestion and mountains further inhibit expansion and impede access to the port area, prompting an elaborate arrangement of car switching and interchange between CN and CP so that the grain arrives at the right elevator. Railcar marshaling yards are located in

[8]The Pacific Rim refers to the Asian countries bordering the Pacific Ocean, including Japan, Korea, China, Hong Kong, Thailand, Malaysia, Singapore, Indonesia, Taiwan, and Phillipines, as well as Australia and New Zealand.

another part of town, hampering coordination between the port and rail yards. Car pooling of CWB grain cars has alleviated the railcar congestion problem at Vancouver somewhat. All cars carrying CWB grains are placed in a single pool to be drawn on without regard to origin or destination. However, a good deal of nonboard grain, which is not subject to car pooling arrangements, is shipped out of Vancouver.

The addition of 270,000 metric tons of new storage capacity has helped increase throughput at Vancouver. However, grain cleaning creates a bottleneck because terminal elevators cannot clean to export standards as quickly as they can receive grain. This problem could be overcome by cleaning more grain inland at new high-throughput primary elevators, which have grain cleaning facilities, or at one of the inland terminals.

Coordinating ship arrivals with grain car movements is always difficult, but it worsens when storage space is short. Grain in storage can compensate for late car arrivals from the prairies, and adequate storage capacity can hold prairie grain pending arrival of ships. The unpredictable nature of sailing schedules and railcar delays en route to port complicate coordination. Coordination takes place among a number of organizations and institutions, each of which is responsible for some aspect of grain sales and movement. The CWB is responsible for sales of board grain, and private grain companies arrange for export sales of nonboard grains. Sales are generally contracted for delivery in 30 days but that can be reduced to as little as 20 days. Orders for grain from the prairies are communicated and railcars allocated by the block shipping system, through the intermediaries of the CWB and the GTA in cooperation with the railways and primary elevators. Notice of ship arrivals at Vancouver is sent to the British Columbia Grain Shippers' Clearance Association. Three to 4 weeks' notice of ship arrival is generally given. However, 4 to 12 weeks may be required to program grain movement from the farm (*10*).

A smooth flow of grain out of the port may be further impeded by seasonal grain demand and the bunching of ship arrivals. Grain demand is highest in the spring when storage space opens up in importing countries and ebbs in summer and fall when their own crops are stored. A study of grain handling and transportation in western Canada pointed out that Vancouver shipments over a year are only 8.5 times the volumes shipped in the busiest month, or the equivalent of 8.5 peak months (*4*). Thus, if ships could be scheduled uniformly throughout the year by scheduling more ship arrivals during the normally slow months, annual shipping capability could be increased to 12 months at peak levels. A more uniform pattern of ship arrivals would mean less congestion at port and would allow the port to operate at a higher throughput level.

The timing of ship arrivals and grain car deliveries is more of a problem at Vancouver than at other grain ports. Vancouver is probably operating closer to capacity than other ports. Capacity of the main rail line to Vancouver is also close to full, slowing down trains from the prairies. Bad weather, such as heavy snows, can also slow down train traffic, particularly in the Rocky Mountains.

All Vancouver's grain shipments are carried on oceangoing ships. Thus, Vancouver suffers from the difficulties of coordinating several other participants, especially foreign shippers, over whom they have little control. By comparison, most of Thunder Bay's traffic is composed of lakers, whose navigation is controlled by the Canadian Lakehead Harbour Commission. Loading of all CWB and some nonboard grain at Thunder Bay is handled by a single agency, the Lake Shippers' Clearance Association, easing the task of coordination. Although ships do bunch at Thunder Bay, greater storage capacity and adequate space reduce the congestion seen in Vancouver.

Better coordination of ship arrivals and grain deliveries to port is a relatively inexpensive way of ensuring smooth operations and increasing throughput capacity at Vancouver. Poor coordination of ship arrivals and grain deliveries to port translates to longer ship waiting times and higher ocean freight demurrage charges, railcar congestion at port, lengthened car cycles, and, ultimately, reduced throughput for the system as a whole.[9]

Prince Rupert. The port of Prince Rupert on the northern coast of British Columbia ships grains and oilseeds from the Peace River area and northern Alberta. Grain shipments from the 63,000-metric-ton terminal elevator have grown from slightly over 500,000 million metric tons in 1974/75 to nearly 1.3 million metric tons in 1981/82. Wheat is the major grain exported; some rapeseed and flaxseed are also shipped.

The port will be enlarged by a 200,000-metric-ton terminal facility being built on Ridley Island in the port of

[9]Demurrage charges are money payable to shipowners for time beyond the agreed number of days allowed for loading and/or discharging (*17*).

Prince Rupert. The terminal is expected to have an annual throughput capacity of 3.5 million metric tons, which implies a turn rate (the number of times stock turns over per year) of 17.5 times, compared with the west coast average of 11 to 12. The facility will augment Canada's ability to serve the growing Pacific Rim markets. Prince Rupert has the advantage of being 1 day's sailing time closer than Vancouver to most of these markets, a difference which can mean important savings in fuel and other costs to customers. An additional 150,000-metric-ton surge storage capacity may be added later.

Construction of the terminal, which had been threatened by escalating cost estimates and funding difficulties, is being financed by the government of Alberta and a consortium of grain companies who will own and operate the terminal. The terminal will draw primarily from the northern grain-growing areas and, therefore, will handle mostly wheat as well as some barley and rapeseed. Prince Rupert is served by a CN line but car interchange agreements between CN and CP will allow some CP-shipped grain from the south to be exported through the new terminal.

Churchill. The Hudson Bay port of Churchill has a short shipping season because ice prevents navigation in all but July through September. The CN rail line to Churchill is built on discontinuous permafrost which prevents the use of fully loaded hopper cars; thus, only the older, smaller box cars can be used on this route. These are being phased out. Besides the difficulties involved in shipping grain out of Churchill, problems of grain assembly and timing impede greater use of the port. Churchill's short shipping season coincides with the preharvest period when elevator grain stocks are low due to the pattern of producer deliveries. The port can handle only one or two types and grades of grain, which are not always available in adequate quantity from the port's normal draw area and must be assembled from remote areas at a greater cost. This problem is exacerbated by the fact that only CN serves Churchill and, when no car interchange agreement is in effect, only grain available at CN delivery points can be drawn upon. Churchill's season also coincides with the time when grain storage space is scarce at destinations in Eastern and Western Europe (*11*).

Churchill possesses the single advantage of being closer than other ports to the European market; however, the ocean freight cost savings from this route are often exceeded by the additional costs of insurance. Low handlings have created financial problems for the port. Shipments peaked at about 750,000 tons in 1976/77 and have been at depressed levels since that time, increasing financial losses to the National Harbours Board which operates the port. Grain is Churchill's only export and few prospects exist for diversification. This isolated town in the far north also has chronic labor problems, owing to the short working season and the difficult working conditions.

Low earnings for the railways are troublesome for all shipments of statutory grain and particularly so for Churchill. Churchill is costly for the rail companies to service because of its remoteness, weight and speed limitations of the line, long turnaround time, difficulties in grain assembly, and requirement of using only boxcars. The railways' normal reluctance to haul statutory grain is, therefore, magnified in the Churchill case.

The Province of Manitoba has a strong interest in seeing that Churchill remains open. Churchill, although currently underused, could provide a valuable outlet for eastbound prairie grain if Thunder Bay becomes congested. Churchill has a strategic value as an Atlantic Ocean port. Considerable investment would be needed to improve the elevator, port facilities, and the rail line before grain could be shipped in significantly larger volumes. The technical challenges of far northern navigation and railcar movement over permafrost must first be resolved.

Port Operations

Potential operational improvements at all of Canada's ports include greater use of grain car pooling, terminal elevator specialization, and coordination of vessel arrivals with grain car shipments.

Grain Car Pooling. Pooling of railcars carrying CWB grain was begun in 1971. Before then, all grain arriving at port was consigned to a specific terminal elevator or grain company, usually the company owning the primary elevator where the grain was loaded. This practice created problems at port because trains had to be broken up in the port yards and cars had to be sorted and switched to get them to the proper elevators. Car turnaround fell and congestion increased. Car consignment resulted in inefficient use of railyard facilities because track space was devoted to extensive car sorting operations. Terminal elevator capacity was also underused when one elevator was pressed to capacity while another one was idle.

Under car pooling, cars carrying CWB grain lose their identity when they are received in railyards; that is, they enter a common pool and can be moved to any terminal

elevator without regard to originating company. Cars are usually distributed to the terminal which has the most available capacity or is most convenient for the railway. Car pooling thus eases port congestion, reduces car cycles, and promotes more efficient use of terminal elevator capacity. Nonboard grains and special consignments are not subject to car pooling. However, these categories account for only about 15 to 20 percent of total shipments. Pooling of CWB grains has helped reduce congestion and increase throughput at both Vancouver and Thunder Bay, and extending car pooling to nonboard grains could further streamline port operations.

Terminal Elevator Specialization. Specialization of terminal elevators in one or two types of grain could improve port operations. Specialization would permit greater use of unit or solid trains because trains carrying one kind of grain could be delivered directly to the elevator. This would promote speedier servicing of ships. Stocks of one type of grain at one elevator may be currently inadequate to make a shipment; ships must then shift from one elevator to another until they accumulate a full load. Shifting adds to port congestion and may increase demurrage charges. However, increased terminal specialization could produce higher levels of congestion in the yards because regular (nonunit) trains would have to be broken up, sorted, and switched to the elevator specializing in the grain carried. It could also increase shifting for those ships collecting more than one type of grain.

Coordination of Ship Arrivals and Railcar Shipments. Railcar delays cause ships to wait for the ordered grain, increasing demurrage charges. Similarly, when ships fail to arrive at the scheduled time, cars may not be unloaded at the elevator because of no bin space. Bunching ship arrivals results in delays and congestion at port. Smoothing out ship arrivals would mean more efficient use of port facilities.

Grain cleaning is, at times, a constraint at Vancouver, where the operation is slower than car unloading capacity. More prairie grain-cleaning at either high-throughput primary elevators or inland terminals would not only speed up port operations but would also provide an additional source of income to primary terminal operators in cleaning charges and in the proceeds from the sale of screenings. The railcar fleet would be better utilized as a result, since dockage levels of even 2 percent mean that one railcar shipment in 50 is comprised of screenings.

Continuous operation of terminal elevators could also increase throughput at ports. The railways run 7 days per week but most terminal elevators operate only 5 days. Operations at ports would be smoother and throughput higher if terminals were operated continuously.

Port Utilization and Capacity

The transport sector's ability to move more grain will depend on the distribution of grain exports among ports. Grain for export could be distributed among ports in order to limit the additional investment in main line capacity and terminal capacity, but the location of production and market demand may make that distribution impossible. The amount moved through each port depends largely on availability of terminal storage and rail line capacity, but will also depend on where additional grain will be produced and where new sources of demand develop (table 9).

Table 9—Estimated current capacity of Canadian grain ports

Port	Capacity
	Million metric tons
West coast:	
Vancouver[1]	12 to 13
Prince Rupert[2]	1.5
East:	
Thunder Bay	18 to 20
St. Lawrence transfer elevators	17 to 18
Churchill	.9
Atlantic	1.2

[1]Main line limitations will reduce effective capacity. Canada Grains Council estimates constrained capacity at 10.5 to 11.0 million metric tons.
[2]Capacity will be expanded to 3.5 million metric tons in the mideighties with the completion of the Ridley Island terminal facility.

Sources: (*11, 32, 51*).

The west coast's share of grain and oilseed exports rose from 41 percent in 1976/77 to 45 percent in 1981/82 while the east's fell, despite rising volumes of grain shipments through Thunder Bay (table 10). Demand from Pacific Rim markets spurred the rise in exports out of the west; most growth in demand for Canadian grain is expected to come from this area. For this reason, the CWB has targeted a 50/50 distribution of grain exports between eastern and western ports by 1985. However, Vancouver will continue to be limited by main line capacity restrictions and Prince Rupert by terminal capacity until additions are in place. These restrictions will make it

Table 10—Exports of Canadian grain and oilseeds, by port sector

Port	1976/77		1977/78		1978/79	
	1,000 metric tons	*Percent*	*1,000 metric tons*	*Percent*	*1,000 metric tons*	*Percent*
Vancouver	6,965	39	7,602	38	7,313	41
Prince Rupert	383	2	837	4	990	5
Churchill	735	4	692	3	495	3
Thunder Bay:						
Direct[1]	1,050	6	916	5	742	4
St. Lawrence[2]	8,144	45	9,247	46	7,946	44
Atlantic	792	4	806	4	575	3
Total	18,069		20,100		18,061	
	1979/80		1980/81		1981/82	
Vancouver	7,940	37	8,304	39	10,339	40
Prince Rupert	1,205	5	1,243	6	1,286	5
Churchill	523	2	289	1	438	2
Thunder Bay:						
Direct[1]	1,225	6	809	4	908	4
St. Lawrence[2]	9,886	46	9,656	46	11,956	46
Atlantic	801	4	730	4	862	3
Total	21,580		21,031		25,789	

[1]Grain exports loaded directly to oceangoing ships.
[2]Includes shipments from lower Great Lakes ports.

Source: (7).

impossible to achieve an equal share of exports through the east and the west by 1985 (*31*).

The CWB goal of shipping at least 50 percent of Canada's exports from western ports is based on the assumption that most of the growth in export demand will arise from the Pacific Rim. However, this goal is not based on any firm projections of the sources of export demand. Grain shipments to the USSR, an important market for Canadian grains and oilseeds in recent years, have historically moved out of Thunder Bay, although Vancouver has become a significant outlet for this market in the last few years. Following are principal destinations served by Canadian ports (*51*):

Vancouver/ Prince Rupert			*Churchill*	
Japan	Mexico	USSR	Poland	USSR
China	East Asia	Peru	East Germany	

Thunder Bay-St. Lawrence	*Atlantic*	*Other*[10]
Eastern Europe	Western Europe	Cuba
USSR	Eastern Europe	Peru

Thunder Bay-St. Lawrence	*Atlantic*	*Other*[10]
Western Europe	Cuba	Bangladesh
Brazil	Caribbean	India
Caribbean		Algeria
Cuba		Iraq
Africa		Poland
Near East		Italy
		Netherlands
		USSR

Studies of world demand for agricultural products have projected that the greatest growth in demand for grains and oilseeds will occur in middle-income developing countries and high-income, food-deficit countries (*24, 28*). Most of the countries in these two categories are located in North Africa, the Middle East, and Latin America which lie in the natural service area of Thunder Bay.

The amount of grain shipped out of each port will also depend on where increases in grain and oilseed production are likely to take place. Saskatchewan will shoulder most of the increase in grain production, according to a study by the Canada Grains Council (*14*). The Province will produce an additional 6.5 million metric tons, compared with 4.7 million additional metric tons in Alberta and about another 2 million metric tons in Manitoba.

[10]Countries that were served by both western and eastern ports in the past 10 crop years but are served predominately by eastern ports (*50*).

Much of the grain produced in Saskatchewan is currently shipped out of Thunder Bay. If past shipping patterns continue, most of the additional grain will be shipped through Thunder Bay and Churchill rather than Pacific coast ports. However, in light of the CWB's strong influence on grain movements via the block shipping system and the delivery quota system, the CWB may direct shipments to west coast ports if market conditions warrant.

Changes in the structure of freight rates for movement of export grain could also affect the east/west distribution of grain exports. The Canadian Government has pledged that any changes in the Crow's Nest Pass freight rates will retain rates that are related to distance. Higher freight rates for export grain could make some grain production areas marginal or even noncompetitive in the export market. Because the areas farthest from port would be the most severely affected by any distance-related freight rate rise, some parts of Saskatchewan and northeastern Alberta could be priced out of the export market, affecting distribution of exports among ports.

If there is a significant increase in demand for Canadian grains and oilseeds in the Pacific Rim markets, then west coast facilities will face the problem of handling the large increase in exports. The Canada Grains Council estimated that exports of prairie grain would total about 31 million metric tons by 1990, short of the 36-million-metric-ton target set by the CWB (*14*). At this level of exports, west coast shipments would top 15 million metric tons based on the 50/50 east-west split. The Grains Council believes that the west coast ports should be able to handle this level of grain exports, if the new Prince Rupert terminal is operating and rail main line expansion projects are finished.

The CWB's higher export target would imply shipments of 18 million metric tons out of the Pacific coast ports, an unlikely level. Vancouver throughput is generally put in the range of 12 to 13 million metric tons and the new terminal at Prince Rupert will bring throughput capacity at this port to 4 to 5 million metric tons per year (*11*). However, main line capacity restrictions are expected to limit car unloads at both ports to below port capacity at least until 1985/86. The railways estimate that 3,000 cars can be unloaded per week at Vancouver and 900 cars at Prince Rupert by 1990 (*32*). Replacing smaller boxcars with hopper cars will allow more grain to be moved within the car unload limits, but this will not significantly increase west coast throughput until the late eighties.

The Rail System

The grain and oilseed trade is served by four main railways: CP Rail, CN Rail, British Columbia Railway (BCR), and Northern Alberta Railway (NAR). CN Rail is a Government-owned railway formed from the consolidation of a number of smaller railways during World War I under the Federal Government's responsibility. It is the largest public utility in Canada. CP Rail is a privately owned joint-stock corporation. CP Rail and CN Rail are by far the most important of the grain-carrying railways, accounting for 94 percent of the volume of grain handled (*4*). NAR is jointly owned by CP and CN Rail and, although it operates independently and owns its own locomotives and cabooses, depends upon the parent companies for rolling stock. The BCR, owned by the Province of British Columbia, operates independently and uses its own equipment (*20*). Both CN and CP serve the two main grain ports of Vancouver and Thunder Bay; however, only CN Rail serves the ports of Churchill and Prince Rupert.

Main Lines

There are two main line systems serving western Canada: the CP main line from Winnipeg to Vancouver by way of Regina (Saskatchewan) and Calgary (Alberta), and the CN main line following a more northerly route by way of Saskatoon (Saskatchewan) and Edmonton (Alberta) to Vancouver and including a spur to Churchill. CN Rail operates a secondary main line from Red Pass Junction in British Columbia north to Prince Rupert (fig. 2) (*19*). Carrying capacity of the main rail lines depends on several factors, including train speeds, schedules, length and location of sidings, and maintenance requirements as well as the length of trains and capacity of cars in trains.

The CP and CN main lines west of Winnipeg are essentially single-track systems, which is one of the sources of the capacity problems in the western transportation system. The rail companies describe the problem as follows (*22*):

> Operating trains over a single track railway is analogous to having two-way road traffic on a single lane highway. Train-length sidings at regular intervals along the route are required so that trains can meet and pass each other. Delays occur everytime trains meet and single-track railroading is therefore a delay-prone operation. At higher traffic levels, cumulative train delays due to meets tend to compound.

Figure 2

CN Rail and CP Rail Western Main Lines

The single-track main line did not present serious problems until the seventies when the increase in the traffic volume began to strain capacity. By the end of the seventies, despite capacity improvements made to the existing line, the capacity of the single-track system had been fully developed to the point where additional capacity increases could only be achieved through double-tracking. Increasing use of larger capacity hopper cars and running longer trains on main lines had eased capacity restrictions because the same volume of grain (or other commodities) can be carried using fewer trains. However, the gains from greater use of hopper cars and longer trains will be limited, particularly as grain and other traffic grows beyond present levels.

Double-tracking, although costly, is the most obvious means of increasing capacity on the main lines. Some sections of double track exist on the CP line to Vancouver, and CN has already undertaken several double-tracking projects for the eighties. These will not be completed, however, until between 1985 and 1988.

The CP Rail main line is also limited by steep grades through the Rocky Mountains. The most serious bottleneck occurs at Rogers Pass where additional locomotives assist trains in negotiating the rise. A grade reduction project, requiring construction of an 8.9-mile tunnel, is planned for this section. The Rogers Pass project, along with three other grade reduction and double-tracking projects, will increase freight capacity on this line by an estimated 45 percent, and reduce the need for additional locomotives (*22*).

Both the CP and CN Rail lines between Calgary or Edmonton and Vancouver are already congested and operating at close to capacity. This section will be the most seriously overloaded through the remainder of the decade, requiring more investment to accommodate projected volumes of all bulk freight (including sizable increases in potash, sulfur, and coal) moving westward on this line. The CN line to Prince Rupert has excess capacity at present and should be able to accommodate the expected growth in freight, although some upgrading will

be required. However, if coal mines located in northeastern British Columbia are to be exploited to serve the Japanese market, sizable additional investments (estimated at about $200 million to $300 million by CN Rail) will be required.

The CN line to Churchill does not have a capacity problem as such, but is load-limited, having been constructed of lighter weight rail over permafrost. Only boxcars can be used on the line. Both the CP and CN lines from Winnipeg to Thunder Bay should be adequate into the foreseeable future.

Branch Lines

About 21,500 miles of rail network carry grain from primary elevator points to export position, according to the report of the Hall Commission (*33*). Much of this rail network, about 19,000 miles of rail line, is located in the Prairie Provinces, and about 16,400 miles of this is classified as branch line. Branch lines join the more remote areas of the country to the main rail lines. The number and condition of the prairie branch lines are among the most serious problems facing the Canadian grain transportation system.

Much of the rail system was built in the early 20th century when grain was the primary industry in western Canada. The system was originally designed to serve farmers who brought their grain to country elevators in horse-drawn wagons. Rail line construction was encouraged by competition among the proliferating railway companies as well as by generous Government subsidies such that, between 1906 and 1935, rail track mileage in the prairies grew from about 6,000 miles to almost 20,000 miles (*33*). The result of the rail line expansion is an overbuilt rail system burdened with too many little-used branch lines that do not provide additional capacity to the railways but, rather, reduce it by slowing down grain collection.

Many branch lines have become unprofitable for the railways to operate. While rising rail tariffs for most bulk commodities made short-haul transport by truck an economic alternative, rail freight rates on grain were frozen at statutory levels and, as a result, grain continued to be transported principally by rail. The only users of rail services on many of the branch lines, were, consequently, grain elevators. Meanwhile, elevator companies began to shut down obsolete operations. Light traffic made continued operation of many branch lines unprofitable and the railways sought to abandon these lines against farmer protests.

A freeze on further abandonments was imposed by the Federal Government in 1967, followed by a series of studies on the branch-line abandonment issue commissioned by the Government. Of total prairie rail mileage, about 12,400 miles, or 66 percent, were designated as part of the permanent network, which is guaranteed against abandonment to the year 2000. Of the remaining 6,300 miles, the Hall Commission recommended that about 1,800 miles be added to the permanent network, about 2,200 miles be abandoned over a 5-year period, and 2,300 placed under the jurisdiction of a proposed Prairie Rail Authority. Reaction to this recommendation showed that "neither elevator nor railway companies were prepared to commit capital to those lines whose fate would remain unknown until 1990" (*43*).

In 1978, a Prairie Rail Action Committee (PRAC) was formed to review the lines that the Hall Commission had recommended for continuing assessment to 1990. Of the 2,500 miles reviewed by PRAC, 1,000 were recommended to be added to the permanent network and 1,400 miles were recommended for abandonment. Removal of abandonment protection was cited for the remaining 100 miles. PRAC also called for trucking assistance to producers for whom branch line abandonment resulted in road hauls of more than 20 miles. The Canadian Transport Commission (CTC) continues to review the recommendations of the various committees. In late 1979, a report of the Clark government called for retention of 600 miles of the lines recommended for abandonment by PRAC.

Thus, of the approximately 19,000 miles of the prairie rail network evaluated since the midsixties, 3,000 miles of branch lines have been abandoned or scheduled for abandonment, and 16,000 miles are guaranteed to stay open until the year 2000.

Rationalization of the prairie branch lines parallels the consolidation of primary elevators, which are becoming fewer and larger, and coincides with the general trend toward fewer and larger farms. Branch-line abandonment may also be justified based on the costs of operating and maintaining aging rail lines versus trucking costs, including road maintenance and energy costs. The PRAC report states (*43*, pp. 18-20):

> . . .the wide spread of branch lines is costly and inefficient, does not preserve small communities,

> will offer poor train service, and [will] frustrate the movement of export grain . . .Keeping branch lines will do nothing to alter the irrevocable trend toward longer voluntary road hauls to take advantage of marketing opportunities, and longer forced road hauls caused by the absolute necessity for elevator companies to close old houses in the interests of marketing efficiency.

Much of the western rail system was built from the late 1800's through 1930. The rail network now suffers from severe deterioration and neglect. Because of statutory freight rates, railways, faced with declining revenues, had little capital to reinvest in rail facilities. Moreover, since railways were losing money on shipping grain, they were reluctant to invest in facilities, such as grain-related branch lines and grain cars, that would promote grain movement. Having once designated the branch lines that would be part of the basic network, the Federal Government encountered the problem of ensuring that these lines would be serviceable until the year 2000. In the summer of 1977, the Government began a branch-line rehabilitation program and committed $700 million to improving roadbeds, replacing light-weight track with heavier weight rail, and replacing switches and other fixtures on 2,300 miles of grain-related branch lines. The Government expected to complete the program in 8 to 10 years. By 1981/82, the Government had already spent $400 million.

The 1967 National Transportation Act provided for a branch-line subsidy program and the first payments were made to the railways in 1970. The subsidy was intended to compensate the railways for the operation of unprofitable branch lines, whose applications for abandonment had been rejected and whose operation was deemed to be in the public interest. Between 1971 and 1981, the subsidy of $971 million partially compensated the two major railways for revenue losses brought about by the statutory freight rates (*30*).

Prairie branch lines still need large infusions of capital to improve the bed and track and to extend sidings at country elevators to spot more cars, which will allow longer trains to be assembled in the country.

Railcar Fleet

The railways' decision not to invest in grain cars in the early sixties in response to chronic revenue shortfall in grain traffic has depleted the grain fleet. Car shortages were one of the earliest symptoms of the growing transportation problem. Between 1969 and 1980, the boxcar fleet fell from 34,000 cars to 12,650 (*30*). Although the railways brought modern hopper cars into service for other bulk commodities, such as potash and sulfur, they did not purchase hoppers for the grain service. In 1982, Canada had about 26,000 grain cars: 11,000 boxcars and 15,000 hopper cars.

Boxcars were, until recently, the workhorse of rail bulk transport. Most of them are now about 30 years old; about 1,800 cars are retired each year. Boxcars can carry only about 50 to 60 tons of grain, compared with the 90 to 100 tons carried by the newer, larger hopper cars. Boxcars are more cumbersome to unload, requiring the use of special dumpers, front-end loaders, or power shovels. Boxcars must also be fitted with special wood or corrugated cardboard interior grain doors before loading. Hopper cars allow grain to flow easily out of the bottom of the car through hoppers into a receiving pit below.

The Federal Government began a boxcar repair program in 1974 in an attempt to ensure adequate rolling stock for the grain trade. Costs of refurbishing grain boxcars were shared by the Government and the railways. Since then, 7,400 boxcars have been brought back into the grain car fleet under the program. Although the expected life of a refurbished boxcar is 7 years, almost all of those repaired under the Government program are still in service. General purpose boxcars are sometimes used to carry grain when general merchandise traffic is low. No new boxcars are being built for the grain service; retired boxcars will be replaced by covered jumbo hopper cars. Hopper cars replace boxcars on a better than one-to-one basis because of their greater capacity. They also reduce car cycle times because, despite their greater capacity, they are easier to pull because of improved bearings and faster to load and unload.

However, some boxcars will be needed to transport grain on certain weight-limited lines, particularly on the CN line to Churchill. The number of boxcars available in 1985/86 is projected at between 5,000 and 6,500 and, given estimated attrition rates of about 100 cars per month, less than 2,000 in 1990/91 (*4, 32*). About 4,500 boxcars are necessary to move grain to Churchill. Boxcars should be adequate through 1985/86, but will not be sufficient to serve Churchill toward the end of the decade, barring any new boxcar repair program. Repairs to keep the boxcar fleet in service will become increasingly expensive as the cars age.

Government of Canada hopper cars loaded with grain are pulled in long trains to shipping terminals. (photo courtesy of Canadian Embassy)

The Federal Government started purchasing grain hopper cars in 1972 to be allocated to the two major railways for the sole purpose of carrying western grain (table 11). The first order of 2,000 hopper cars was placed in 1972. Subsequent purchases by the Federal Govemment, the Provinces, and the CWB brought the total number of grain hopper cars to over 15,000 by the end of 1982 (table 12) (*19*). In early 1983, the Federal Government committed to purchasing 3,840 more hopper cars between 1983/84 and 1985/86. The cars, although owned by the governments and the CWB, are maintained by the railways. All the 90-metric ton hoppers have been allocated to CN, which has a greater proportion of weight-limited branch lines.

Improving car cycles is one way in which existing equipment can be better used. A car cycle is the number of days required for a railcar to be spotted and loaded in the country, to depart and travel to port, to arrive at port, to unload, and to return to the country. Car cycles vary according to port destination (longest to Prince Rupert, shortest to Thunder Bay), car type (longer for boxcars than for hopper cars), railway (longer for CN than CP), and season (longest in winter and shortest in summer). Car cycles are longer for boxcars and on CN lines because boxcars usually travel from the most remote points in the country where branch lines are often load-limited and movement is slower (*4*). Boxcars must be inspected more frequently, which tends to slow their movement. Installing and removing grain doors also lengthens boxcar cycles.

Table 11—Purchases of grain hopper cars

Year	Purchaser	90-ton aluminum	100-ton steel
		Number	
1972	Federal Government	N/A	2,000
1974	Federal Government	1,600	2,400
1977	Federal Government	800	1,200
1979	Canadian Wheat Board	N/A	2,000
1980	Federal Government	N/A	[1]2,000
1981	Province of Saskatchewan	N/A	1,000
	Province of Alberta	N/A	1,000
1982	Federal Government	N/A	1,280
Total		2,400	12,880

N/A = not applicable.
[1]Long-term (25-year) lease.

Source: (*18*).

Table 12—Size and composition of the Canadian grain car fleet

Year	Boxcars	Hopper cars	Total
		Number	
1976	20,000	6,000	26,000
1977	15,000	8,000	23,000
1978	14,000	8,000	22,000
1979	12,500	8,000	20,500
1980	15,952	11,217	27,169
1981	13,938	14,178	28,116
1982	11,000 (est.)	15,300	26,300

Sources: (*26*, *31*).

Average car cycles were reduced from 22.8 days in 1974 to 19.0 days in 1977; however, improvement in car cycles from 1977 to 1980 was much less, falling by only 0.2 day to an 18.8-day average (*45*). Car cycle times could be reduced by an estimated 15 percent by 1985/86 from 1977/78 levels, saving the equivalent of 4,000 cars (32). Car cycle improvement will not only reduce the need for additional car requirements but will mean less congestion on the main lines and at port. A study of the western Canadian grain handling and transportation system stated that the 15-percent car cycle reduction could come from better coordinating car flows, extending hours of elevator operation, increasing use of layover turns, and upgrading weight-restricted branch lines to permit use of hopper cars and improved speed(*4*).[11] Car cycle improvements would also result from a rapeseed car exchange program at the port of Vancouver, switching improvements in the yards at Thunder Bay, and better matching of car deliveries with ship arrivals.

Future Carrying Capacity

Carrying capacity of the grain car fleet depends not only on the number and types of cars and the length of car cycles, but also on the degree of improvement in coordination, the pace of branch-line abandonment or upgrading, and the amount of grain shipped through each port. The 50/50 distribution of exports between eastern and western ports will require more cars to move the same amount of grain because car cycle times are longer to west coast ports than to Thunder Bay. If car unload constraints at Vancouver and Prince Rupert make the 50/50 split impossible, fewer new cars will be needed. The 15-percent targeted reduction in car cycles will also reduce the number of cars needed. Assuming improved car cycles, the GTA estimated that 5,110 cars would be required by 1985/86 and an additional 3,090 cars required by 1990/91. Without cycle time reductions, estimated car requirements were higher.

[11]Layover turns refer to placing cars on one shift, resting the train crew on the next shift, and picking up cars on the third shift on the return run.

Any forecast of capacity must also be made in the context of a rapidly evolving system. As recently as 1979, it was predicted that the grain fleet would peak in 1981 (*4*). Current estimates of car numbers, Government purchases, and boxcar retirement rates would now have the number of cars (although not capacity) peaking in 1983/84 (*32*). External factors, such as the size of the crop, economic conditions, and weather, change, making estimates for any one year all but impossible. For example, the 3,000-car-per-week unload constraint at Vancouver, which forms the basis of GTA projections, was already surpassed in 1982, aided by slack capacity in the transportation system due to diminished traffic in other bulk commodities. Boxcar supply is difficult to predict because not all boxcars are grain-dedicated, and may move in and out of the grain fleet. Also, some boxcars rehabilitated under the Federal Government's repair program have remained in the fleet beyond their expected life span. Replacing boxcars with hopper cars will increase the carrying capacity of the fleet. Because hopper cars can carry more grain than boxcars, increasing the number of hopper cars will increase the average capacity per car. Use of hopper cars will also result in time savings because of the ease of loading and unloading. To achieve the fullest use of hopper cars, however, will require upgrading certain load-limited branch lines which currently can only support boxcars or partially loaded hopper cars.

GTA estimates of car supply and requirements formed the basis of the most recent Government hopper car purchase program. The Federal Government committed to purchasing 1,280 grain hopper cars in 1982 and to add 1,280 cars in each of the 3 following years. This program will bring the grain hopper car fleet to 19,120 cars by 1985/86. The GTA estimated that boxcar numbers would decline to 6,600 by that year, and to about 2,000 by 1990, barring any new boxcar repair program. Estimated fleet capacity based on currently planned additions to the hopper car fleet and GTA estimates of boxcar numbers, 1977/78 average car cycles, and average loads per car type is about 36 million metric tons in 1985/86 and 31-32 million metric tons in 1990/91. Domestic rail movements of western grain of 5 to 6 million metric tons must be also accommodated by the grain car fleet. Thus, barring any improvements in car cycles, carrying capacity of the currently planned grain car fleet is expected to be extremely tight in 1985/86 and inadequate to carry targeted grain exports by 1990/91.

Unit trains are the most efficient and successful movers of large quantities of grain by land to port in the United States. A unit train carries all of the same kind, grade, and quality of commodity, such as coal or grain. The train is usually marshaled at a single point and moves as a unit to a single destination where the cars are unloaded in a single operation. Unit trains usually comprise 100 or more cars; however, car cycles have declined by 50 percent or more in unit train grain shipments consisting of 25 cars or more (*51*). Solid trains differ from unit trains by carrying all grain but not necessarily the same kind, grade, or quality. Solid trains are usually not assembled at a single point nor delivered to a single destination and may have interim stops. Most grain movement to port in western Canada is in solid grain trains from one of the large distribution yards (*33*). Unit trains reduce car cycles by bypassing the intermediate distribution and classification yard operations where trains from branch lines are broken up, sorted, and reassembled for movement to ports. Delivering all cars in a train to a single elevator at port would further improve turnaround by avoiding disassembling and switching operations in terminal yards.

However appealing the concept of unit trains may be, it has limited application to western Canadian grain operations. The variety of grades, types, and qualities of grains, for example, works against the unit train, because even the large inland terminals seldom possess sufficient grain of one grade and quality to load 100 or more hopper cars. Few, if any, inland elevators have a loading track capable of supporting a unit train. Port terminals have neither the capacity to unload 100-car unit trains at terminal elevators nor directly to vessels (*33*).

High densities of grain, broad grades, and long unbroken distances between country origins and large export terminals are some of the conditions which favor unit train operations (*29*). Canada has relatively low density grain availability and narrow and numerous grades. While distances are long, intermediate stops for car switching and train assembly are common. Large volume movement of individual grains in unit trains means that terminals must specialize in certain grains(*9*). Canada's grain marketing system, which attempts to equalize delivery opportunities among shipping blocks, may frustrate attempts to collect grain in sufficient quantities for unit train shipment. Statutory freight rates remain the single greatest obstacle to the increased use of unit trains for grain. Because rates are already below their costs, railways have no means of increasing the feasibility of unit trains by offering rate incentives to encourage shippers to organize grain in multiple-car quantities.

While the unit train may not be immediately useful for western grain movement, variations on it may improve shipping. Multiple-car consignments from subdivisions could reduce car cycles and streamline shipping. Multiple-car shipments could be assembled from inland terminals or some of the large, high-throughput elevators. Consolidation of the primary elevator system should increase the possibilities for unit train movements as grain supplies become more geographically concentrated.

Unit trains are used in the CWB's winter rail export program from Thunder Bay to the lower St. Lawrence River elevators at Montreal and Quebec. This program permits continued export shipment from eastern terminal elevators when the seaway is frozen over. These trains consist of 90 to 110 cars and can carry up to 10,000 tons of grain. The system has the potential of running at least one unit train per day on each rail line; the limitation to expanding this program would arise in the unload capability at the St. Lawrence ports (*52*). Unit trains are also used for winter shipment of export grain placed in Georgian Bay and upper Great Lakes transfer elevators and railed to Atlantic coast ports. Unit trains direct from the prairies to eastern ports could be a particularly valuable alternative to Great Lakes-St. Lawrence shipping if capacity is reached at Thunder Bay. Use of unit trains would be more attractive if the At and East subsidy, which reduces costs to shippers from inland ports to export position, were removed. With the subsidy, it is not possible to offer incentives in the form of lower freight rates for using the more efficient mode.

Coordination of Grain Movements

In a system which has been plagued by bottlenecks, car shortages, tight capacity, and congestion, the role of coordination of the various components becomes extremely important. This is particularly true because of the number of participants in the Canadian grain handling and transportation system. In addition to the producers and the railways, there are Government agencies and quasi-governmental entities, including the Canadian Grain Commission, the Grain Transportation Authority, and the Canadian Wheat Board, producer cooperatives and private grain companies, and, to a certain extent, the Federal and Provincial governments.

Transporting grain for export in Canada contrasts with the U.S. system where major exporters (both the private companies and cooperatives) frequently operate primary elevators. U.S. grain exporters more easily obtain rail service because they are major customers and because of the availability of other modes of transport (*10*). Most export grain in Canada is handled by the CWB, while primary elevators are operated by private grain companies and producer cooperatives. The CWB, along with the GTA, coordinates shipping with the railways, the elevator companies, and arriving ships through the shippers' clearance associations. Control is indirect and therefore more difficult. Nonboard grain must also be accommodated within the overall ordering scheme.

The CWB controls the flow of grain from producers to the primary elevator system through the delivery quota system. The system regulates the flow of grain from farms to maintain a relatively even flow over the crop year and to equalize delivery opportunities among producers. The system also enables the CWB to call forth grains needed to satisfy market demand. Based on sales commitments and stocks in elevators, the CWB announces delivery quotas for a certain volume of a grain at primary elevators in a defined geographic region. Producers receive delivery permit books containing a record of their quota acreage and deliveries during the crop year. The producer's quota acreage is determined by the area sown to grains and oilseeds plus forage and summer fallow. Delivery quotas are issued on a kilogram-per-quota-acre basis; thus the quota acreage determines how much grain the producer will be able to deliver to primary elevators. The CWB also issues quotas on nonboard grains after consulting with grain exporters.

Responsibility for coordinating grain car movements in western Canada is shared by the CWB and the GTA. The GTA was formed in 1979 upon recommendation made in a study of the grain handling and transportation system commissioned by the Federal Government (*4*). The study recommended that a neutral party oversee allocation of railcars between board and nonboard grains, which had been the responsibility of the CWB. Problems of coordination may have arisen out of a perceived conflict of interest by the CWB which had "a direct interest in marketing board grain yet whose staff control rail car allocations for both board and nonboard grains" (*4*). A grain transportation coordinator was appointed in December 1979 and the GTA assumed full responsibility for initial car allocation in March 1980. GTA allocates railcars to ensure that they are distributed fairly between board and nonboard grains as well as among shippers of nonboard grains.

The GTA determines the number of available railcars along with the railways. The GTA then divides the cars between shippers of board grain and shippers of nonboard grain. About 80 percent of all grain moved through the system and about 90 percent of all grain exports are board grains (*52*). Some cars may also be allocated to fill requests for producer cars from the CGC. The GTA allocates nonboard grain cars by type of grain among the various elevator companies. At the same time, the CWB distributes its allocation of railcars by grain type among shipping blocks and by elevator company within each block. The elevator company assigns cars to individual elevators in the country for both board and nonboard grains. The CWB places orders for shipping grain with elevator managers and the railways (*31*).

Block Shipping System

The block shipping system divides grain-producing areas in the prairies into 48 regions called blocks. The block is the basic planning unit for coordinating the delivery and movement of prairie grain. Each block is served by one railway, about 400 miles of track, 40 shipping stations, and 125 elevators (*53*).

The block shipping system evolved from a need to develop techniques for control of railcar allocation and movement that would be more compatible with the grain marketing under the CWB. Before the block shipping system, cars were allocated by the railways according to the shipping orders issued by the CWB to individual elevators. Delivery quotas applied to individual elevators or delivery points. Under the block shipping system, more emphasis was placed on allocating shipping orders to meet market demand and less on strict equality of delivery opportunity for individual producers.

A 6-week cycle is the basis for projecting the amount of grain to be shipped through each port. In the first week, the CWB plans the amount of grain required for loading to ships 6 weeks hence, as well as board grains required for eastern processors and domestic feed use. The CWB decides the number of cars needed to be shipped to each port to meet export and domestic requirements. GTA makes an initial division between board and nonboard grains. Grain cars are divided between board and nonboard grains for each port based on relative sales positions, ship arrivals, market outlook, processing capability in terminals, and stocks on farms and primary elevators.

During the second and third weeks, the CWB receives reports of available stocks from elevators and makes an initial allocation of railcars to each shipping block, depending on the availability of the types and grades of grain, congestion, closeness to port from which grain will be shipped, and equity under the delivery quota system. The GTA negotiates the car supply with the railway and makes a firm allocation of railcars for board and nonboard grain to shipping blocks among elevator companies. The grain companies decide which elevators will receive the nonboard cars. The board grain cars are distributed to companies based on the percentage of each company's business in the block. The grain companies then distribute the shipping orders among individual elevators. The orders are sent back to the CWB which breaks them down into train runs which are confirmed with the railways. The railways in turn advise elevator managers of the number of cars they will receive, types and grades of grain to be loaded, and destinations.

During the fourth week, cars are spotted and loaded at the elevators, are picked up in return train runs, and are sent to prairie distribution and classification yards and to port destinations. The cars are unloaded at terminals or processing plants and the grain is prepared for shiploading in the fifth week. Ships are loaded during the sixth week. About 10,000 orders for shipping grain are processed each week. The system is flexible enough so that changes to shipping orders or car allocations can be made until the middle of the fourth week (*53*). A new 6-week cycle is initiated each week.

Producer Cars

The GTA and the CWB do not control allocation of all railcars carrying grain in western Canada. Producer cars are allocated by the CGC, which sets a weekly limit of 100 producer cars. The producer car must be worked into the overall shipping program by the CWB. Producer car use was light (100 to 400 cars) up until the late seventies, but the numbers grew to 1,000 in 1977-78, to more than 4,000 in 1978-79, and have remained high (table 13). The recent increase in producer car shipments may be in response to the severity of the congestion in the primary elevator system or a tight supply of grain cars; that is, producers may be more willing to go through the complicated procedure of loading their own grain on a producer car to ensure that their grain gets to its destination.

Producer car shipments have traditionally accounted for less than 1 percent of all grain shipments. The Hall Com-

Table 13—Producer car loadings

Year	Cars loaded	Year	Cars loaded
	Number		*Number*
1971-72	183	1977-78	1,042
1972-73	193	1978-79	4,636
1973-74	181	1979-80	2,078
1974-75	96	1980-81	2,954
1975-76	394	1981-82	3,282
1976-77	250		

Sources: (*1, 5, 33*).

mission suggested that the use of producer cars' share could be increased to 5 percent (*33*). It reported that producer car use could be particularly useful when the primary elevator system consolidates and more elevators are closed. If a rail siding is left in place, producers affected by the elevator closings will have the option of shipping their grain in producer cars. However, producer cars are not efficient for moving large quantities of grain, because they are virtually a single car pickup and delivery system requiring separate treatment and more paperwork than the standard carload shipment.

Prospects for Nonagricultural Bulk Exports

Grain and grain products, although extremely important to the western Canadian economy, are not the only important source of export earnings for this region. Bulk commodities such as coal, potash, sulfur, and lumber are produced in and exported from the west. They compete with grain for transportation facilities. Because movement of these bulk commodities is not subject to statutory rates, they tend to pay their own way and may partially compensate for the revenue lost in grain movement. Coal, potash, and sulfur shippers are charged about 2 cents per ton-mile, while grains and oilseeds for export are charged 25 percent of that amount (*6*).

The value of these other bulk exports has, on the average, accounted for a share of total export value roughly equal to that of grains and oilseeds. Over the last 10 years, 8 percent of total export value was attributed to grains and oilseeds, and 7.1 percent to coal, sulfur, potash, and lumber. Their combined export value overtook the value of grain and oilseed exports in 1977.

Nonagricultural bulk exports have been growing at a faster rate than grain exports: the total value of coal, sulfur, potash, and lumber grew at an average annual rate of 22.1 percent over the period compared with 18.4 percent for grains and oilseeds (table 14). Combined exports of coal, sulfur, and potash have exceeded the volume of grain and oilseed exports since 1973 (table 15). The volume of all four bulk export categories grew faster than grains and oilseeds. Only sulfur export volume grew at a slower pace than grains and oilseeds.

Recent poor economic conditions in much of the world have slowed demand for nonagricultural bulk products. However, this short-term deviation will likely reverse with rising demand as economic conditions improve. Growing exports of western minerals and lumber as well as grain and oilseed exports will put more pressure on the already taxed western rail system. The two major Canadian railways have predicted a 92-percent increase in rail traffic in bulk commodities (including coal, potash, sulfur, and grain) from 1980 to 1990; and 70 percent of this growth is expected to occur in western Canada (*21*). Rationing of rail availability has been discussed as a remedy to growing levels of commodity shipments to the west coast (*44*). Unless some means is found to reimburse the railways for their losses in moving grain at statutory rates, capital will not be available for the expansion and upgrading required to accommodate the expected growth in bulk exports.

Grains and oilseeds are more costly to move than other bulk commodities because of their multiple origins and destinations and various types and qualities. As stated in the Canada Grains Council's Pacific Coast Study (*10*):

> The effort expended by the railways in the movement of grain is substantially greater than that for equal volumes of other bulk commodities. Commodities such as coal originate in a minimum of locations, mines being unique operations, where grain must be collected from a multitude of lines serving the primary elevators. Minimal differences in product attributes exist in other bulk commodities from unique sources, while grain must be segregated by type and quality. Furthermore, grain in contrast to other bulk products must be delivered to a number of terminals at the port. The end result is that the present grain handling system demands a disproportionately high share of railway capacity as compared with movements of other bulk commodities.

To the extent that these other bulk commodities provide adequate compensation to the railways, their shippers

Table 14—Value of Canadian grain and oilseed exports, selected nonagricultural bulk exports and all commodity exports

Year	Grains and oilseeds (1)	Coal (2)	Sulfur (3)	Lumber (4)	Potash (5)	Sum of (2) - (5) (6)	Value of all commodity exports (7)
				Million dollars			
1970	1,159	29	44	664	121	858	16,458
1971	1,461	53	28	829	143	1,053	17,424
1972	1,549	106	28	1,020	148	1,301	19,500
1973	2,122	165	45	1,598	184	1,992	24,644
1974	3,054	252	91	1,289	276	1,908	31,293
1975	3,121	478	113	972	292	1,856	32,096
1976	3,026	557	110	1,647	408	2,722	37,259
1977	3,088	596	122	2,387	468	3,574	43,328
1978	3,431	690	164	3,229	494	4,577	51,719
1979	4,225	732	207	3,911	721	5,570	64,194
1980	5,817	794	543	3,350	946	5,634	74,229
				Percent			
Average annual growth rate 1970-80	18.4	43.4	38.2	21.7	23.9	22.1	16.5
Change 1970-80	394.0	2,622.0	1,133.0	405.0	680.0	656.0	451.0
Average share of all commodity exports 1970-80	8.0	1.0	--	5.0	1.0	7.1	100.0

Note: All data rounded.
-- = Less than 1 percent.

Source: (*47*).

Table 15—Volume of selected Canadian bulk exports

Year	Grains and oilseeds products[1]	Coal	Sulfur	Potash	Lumber
		1,000 metric tons			*Million board feet*
1970	16,922	4,392	2,988	4,966	7,466
1971	19,944	7,734	2,648	5,451	8,526
1972	20,498	8,513	2,848	5,750	8,910
1973	14,887	12,024	3,850	7,129	9,969
1974	14,065	11,876	4,686	9,044	6,554
1975	17,247	12,891	3,634	7,242	6,551
1976	18,351	12,965	4,101	8,278	9,674
1977	20,224	12,069	4,291	9,220	12,314
1978	18,234	13,657	4,985	9,388	13,440
1979	21,739	13,853	5,155	10,643	13,374
1980	21,185	14,311	6,850	10,538	12,377
			Percent		
Average annual rate of growth	3.4	13.5	2.1	8.6	7.2
Change 1970-80	25.0	226.0	129.0	112.0	166.0

Note: All data rounded.
[1]Crop year basis.

Source: (*46*).

will be in a better position to demand service from the railways and railways will be more likely to provide it. The rising value of nonagricultural primary product exports may blunt the argument for maintaining preferential rail rates for grains and oilseeds based on their important contribution to Canada's balance of payments.

Increased shipments of nonagricultural bulk commodities also have important implications for port facilities. The greater part of these bulk exports is shipped through the crowded port of Vancouver. Western Canadian coal production is expected to rise with the expected increase in world demand for low-cost alternatives to petroleum and the growing metallurgical industries in Japan and elsewhere. Canada's Department of Energy and Department of Mines and Resources have estimated that coal production will grow from about 35 million metric tons in 1980 to 57 million metric tons in 1990 to over 100 million metric tons in the year 2000. Most of this growth will be in the west (*39*). The port facility planned for Prince Rupert will be able to handle larger volumes of export grain in addition to some coal, but not until 1985. Exporting coal via Prince Rupert will require construction of a rail line connecting British Columbia coal fields with the main line to Prince Rupert.

A recent study by the Canadian Department of Energy concluded that (*39*):

> In 1979 all four commodities [coal, potash, sulphur and grain] accounted for 28.1 million metric tons, or 80 percent of the total shipped from the ports of Vancouver and Prince Rupert. By 1985, export shipments are expected to reach 45 million metric tons for the same commodities. Capacity limits of the main lines between the Canadian Prairie provinces and the Pacific Coast are already near capacity. Therefore, rail capacity needs to be expanded rapidly in order to handle any significant increase in future mineral development.

Tonnage figures give an indication of the recent growth in bulk commodity exports through Vancouver (table 16). Growing levels of western primary products will put greater strains on the railway system and the port of Vancouver. The railways claim that revenues are not adequate to finance the upgrading and new construction required for increasing volumes of bulk exports. Demands for better rail service by shippers of coal, potash, sulfur, and lumber may put increased pressure on the Canadian Government to stem the railways' revenue shortfall.

When export of these products picks up with economic recovery, the rail capacity availability that enabled Canada to export record amounts of grain and oilseeds in 1981/82 is likely to disappear, and port and main line congestion and railcar shortages may resume.

Prospects for Eastern Grain Transportation

Greater pressure will be placed on the eastern sector as exports of both Canadian and U.S. grain expand to meet

Table 16—Principal nonagricultural commodity exports loaded at Vancouver

Year	Coal	Sulfur	Lumber and timber	Potash	Total
			1,000 metric tons		
1970	3,371	1,233	845	1,080	6,529
1972	7,545	1,492	1,470	1,501	12,008
1973	9,087	2,050	1,185	1,299	13,621
1975	11,325	1,739	1,440	1,878	16,382
1976	9,249	2,125	1,913	1,476	14,763
1977	9,423	2,649	2,228	1,322	15,622
1978	4,945	2,413	2,070	1,602	11,030
1979	6,185	3,091	2,253	2,498	14,027
1980	13,135	4,756	2,628	3,066	23,585
			Percent		
Change, 1970-80	390	386	311	284	261

Note: All data rounded.

Source: (*46*).

demand. Areas which are possible constraints to higher throughput levels include the laker fleet, Thunder Bay terminal capacity, St. Lawrence transfer elevators, and the Welland Canal.

Canadian Laker Fleet

The Canadian laker fleet, numbering about 90 ships in 1981, moves almost all the grain through the Great Lakes-St. Lawrence Seaway. The largest seaway laker is theoretically capable of moving about 350,000 metric tons per year (26,000 tons per cargo, about 12 to 15 cargoes per year) although the lakers typically move much less than that. These shipments include not only Canadian shipments of western grain to eastern transfer elevators for export, but also shipments of western Canadian grain to transfer and process elevators for domestic use and shipments of U.S. grain through the lakes to St. Lawrence transfer elevators. Of the current laker fleet, fewer than half the ships are full seaway size. The average laker carried 17,000 tons per trip and sailed eight times in 1979 (*13*). The number of transits per ship depends on the number of grains loaded, the efficiency of port operations, and the availability of backhaul. Backhauls, particularly of iron ore from Quebec, improve profitability of the laker, but extend turnaround time.

Concern that the laker fleet might not be adequate to accommodate future shipping volumes began to develop in the late seventies, when record shipments of Canadian grain coincided with heavy demand for laker freight by U.S. grain shippers. In 1978/79, U.S. grain shipments on lakers totaled about 6 million metric tons; most of this was handled by Canadian lakers (*13*). Lakers moved about 8 million metric tons of Canadian grain for export and about 6 million metric tons for domestic use. Total volume of grain hauled by lakers increased to a record 22 million metric tons in 1981, about 8 million metric tons of which originated at U.S. Great Lakes ports (*55*). Pressure on the Canadian laker fleet is expected to grow as Canada increases its grain exports over the decade and as U.S. Great Lakes grain shipments grow to avoid the bottleneck at Locks and Dam 26 (Alton, Illinois) on the Mississippi River.

Canadian shipowners will probably need to add from 5 to 33 new lakers to the fleet to meet the expected growth in demand for lake freight over the decade (*13, 51*). Four additional lakers will be added to the fleet by 1984, including three being built under an agreement between the CWB and three lake shipping companies. The CWB made minimum tonnage guarantees over the next several years in exchange for the companies' promise to build new lakers. These agreements will ensure a supply of lake freight for Canadian grain shippers who, at times, compete with U.S. shippers for available vessels.

Shipowners have been reluctant to invest in additional lakers because of the fluctuations in Great Lakes grain traffic and changes in Canadian Government policy which formerly encouraged such investment with a Federal subsidy of 20 percent of the shipbuilding costs. The decline in backhauls of iron ore from Quebec over the last few years because of the slump in the U.S. steel industry has also discouraged investment in lakers.

Laker capacity will likely be tight in 1985 and inadequate by 1990 unless more lakers are added. The need for new lakers would be reduced with improvements in turnaround time (particularly if port operations such as vessel shifting are improved), increased use of alternate modes such as the all-rail route, and a longer seaway shipping season. Lake fleet capacity available to Canadian shippers will also depend on how much additional U.S. grain is shipped through the Great Lakes.

Thunder Bay Capacity

Thunder Bay capacity may be inadequate to handle future shipping. Although storage capacity is quite large (close to 2.1 million metric tons), the port can become congested at levels of stocks below capacity. Car switching problems and vessel shifting can also restrict throughput.

Increased use of unit train shipments from Thunder Bay (or direct from the prairies) to eastern transfer elevators would circumvent the potential bottlenecks of inadequate lake fleet capacity and the impending Welland Canal problem. The difficulties involved in assembling unit train-size loads have worked against increased adoption of this mode. Car unload capacity at the ontrack St. Lawrence elevators is limited, and the larger elevators at Port Cartier and Baie Comeau do not have rail access. Shippers are reluctant to resort to unit trains except when the water route is unavailable because unit trains are still more costly than lakers.

Replacing older, smaller lake bulk carriers with full seaway-size ships would relieve the constraint at the Welland because the grain could be moved in fewer

A ship at Thunder Bay receives its load of wheat for export. (photo courtesy of Canadian Embassy)

ships, requiring fewer transits. However, expanding the fleet costs a nearly prohibitive $30 million per ship.

St. Lawrence Transfer Elevators

Transfer elevator capacity is expected to be inadequate by the end of the decade. The handling capability of the six St. Lawrence transfer elevators is estimated at 18 million metric tons (51). Up to 40 percent of this capacity may be occupied by U.S. grain transshipments. U.S. transshipments could exceed 9 million metric tons by 1985 and 14 million metric tons by 1990 (provided, of course, that capacity exists to handle the increase) (*51*). Total export clearances of U.S. and Canadian grain through these elevators are forecast to be between 18 and 21 million metric tons in 1985, and between 27 and 29 million metric tons in 1990 (*4, 32, 51*). Current transfer elevator capacity will be inadequate for future grain exports if they reach projected levels. A new transfer elevator planned for Gros Cacouna, Quebec, which should add 2.4 million metric tons capacity in the mideighties, will not overcome the prospective capacity shortfall.

St. Lawrence Seaway and Welland Canal

The limitation to increased shipping through the Welland Canal is the size and number of ships it can accommodate during the shipping season (*51*). The canal, linking Lakes Erie and Ontario, was deepened by the United States and Canada to a draft of 27 feet in 1959. Although deep enough to accommodate most ocean ships at that time, ocean ships have increased in size and draft since then. Thus, most of the traffic through the canal now consists of lakers and small ocean ships, meaning more trips by the smaller vessels to move the same amount of grain. Traffic from both the U.S. and Canadian sides has also grown over the years to the point that the Welland is expected to reach its capacity by the mideighties.

Capacity constraints on the Great Lakes-St. Lawrence Seaway route that may come about because of an inadequate laker fleet or capacity restrictions on the Welland Canal could be overcome in a number of ways. Lengthening the seaway shipping season by 1 month would increase throughput capacity by 12 percent with no additional investment except for equipment to control ice. Extending the shipping season would increase laker use; lakers currently are inactive for about a third of the year. The proposed season extension has been opposed by regional governments, notably the State of New York, on environmental and other grounds, and by some Canadian Government officials who argue against it as being too costly.

Alternatives to extending the seaway season include costly capacity improvements to the Welland Canal itself, increased use of full seaway-size lakers, and use of alternate routes for moving grain such as an all-rail mode by unit train out of the prairies, or more rail or truck shipping of Ontario grains.

Capacity restrictions on shipment of Canadian grain via the Great Lakes and St. Lawrence Seaway will also depend in large part on the level of U.S. grain shipments via this route. The Great Lakes are a costly route to ship grain compared with the Mississippi barge route. The Great Lakes route even compares unfavorably with unit train shipment to Norfolk from States bordering the Great Lakes because of the highly favorable rail tariffs charged on unit train shipments. The Great Lakes ports have carried, on the average, less than 15 percent of total U.S. grain exports.

This pattern may change because the restrictions on Locks and Dam 26 on the upper Mississippi River have limited the barge traffic from the upper Midwest. Improvements to this bottleneck will not be completed until the late eighties. A large increase in U.S. grain exports will affect all export sectors. The volume of U.S. grain moving through the Great Lakes-St. Lawrence Seaway is expected to increase, adding pressure on this sector.

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